CONTRIBUTIONS TO THE HISTORY OF NORTH AMERICAN ORNITHOLOGY

Edited by

WILLIAM E. DAVIS, JR.
and
JEROME A. JACKSON

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CONTRIBUTIONS TO THE HISTORY OF NORTH AMERICAN ORNITHOLOGY

MEMOIRS OF THE NUTTALL ORNITHOLOGICAL CLUB, NO. 12

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MEMOIRS OF THE NUTTALL ORNITHOLOGICAL CLUB

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4. The Birds of the Cambridge Region of Massachusetts. William Brewster. 1906. 425 pp., 4 pl., 3 maps.
5. Supplement to the Birds of Essex County Massachusetts. Charles Wendell Townsend. 1920. 195 pp., 1 pl., 1 map.
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10. A Bibliography of the Published Writings of William Brewster. Charles Foster Batchelder. 1951. 54 pp.
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12. Contributions to the History of North American Ornithology. William E. Davis, Jr. and Jerome A. Jackson, editors. 1995. 501 pp., 108 figs.

Nuttall Ornithological Club
Cambridge, Massachusetts
© 1995 by Nuttall Ornithological Club
All rights reserved. Published 1995.
Printed in the United States of America
ISBN 1-877973-36-X

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Preface

This book had its genesis in a symposium on the history of North American ornithology which we organized for the 1991 annual meeting of the Association of Field Ornithologists at Ohio Wesleyan University. Because of the positive response to the symposium, and because the history of North American ornithology has received surprisingly little attention, it seemed desirable to provide an outlet for the publication of the papers presented at the meeting. In order to produce a book-length manuscript, we invited the participation of several additional authors.

The original papers from the symposium represented a veritable potpourri of topics. Four of the presentations were revised to form the nucleus for this book. In order to round out the volume, we solicited papers on the contribution to ornithology from major institutions, museums, and United States governmental agencies, and some dealing with more general subjects. We attempted to balance our North American representation by inviting three papers on Canadian institutions and ornithology. The final product is not an exhaustive treatment, since the variety of the original presentations precluded concentrating on a narrow topic (e.g., institutions), and all who were invited to contribute were not able to. But we hope the quality of the papers presented here will stimulate others to fill in some of the gaps and we look forward to preparing a future volume or volumes.

We have placed the chapters on institutions at the beginning of the book, and have them arranged in approximately the order in which the institutions were founded. Following these are the three chapters on Canadian ornithology, chapters on more general subjects, and in conclusion a chapter on the literature of the history of American ornithology as a guide for further research.

Most of the chapters presented here are "court histories," written by people who participated in making the history they write about. Despite the obvious potential for bias, we think that histories written by "insiders" have some advantages over those prepared by "disinterested" historians. Insiders have the advantage of personal experience, an intimate knowledge of their subject matter, and access to rich anecdotal material which adds flavor, or "jizz" (to borrow a birder's term for distinctive character and style) to a descriptive or interpretive history. Hence we have encouraged authors to include personal insight and opinion (and occasionally gossip) because we think that these help to create a better sense of the "personality" of the subject matter.

Most of the histories presented here are more descriptive than interpretive, but as such, are a useful first step in future analysis. We hope that the essays in this volume will provide a stimulus and interest, as well as a source of references, for future students of the history of ornithology. This is our primary intent in producing this volume.

We thank Mark V. Barrow for his thoughtful comments on drafts of this preface. We especially thank all the authors for cheerfully enduring our editorial surgery and constant harassment about deadlines.

This book was co-edited by us, and the order in which our names appear on the title page was determined by the flip of a coin.

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1

Philadelphia: 180 Years of Ornithology at the Academy of Natural Sciences

Frank B. Gill[1]

ABSTRACT.—The Academy of Natural Sciences is now over 180 years old and still prospering. This chapter summarizes the highlights of nearly two centuries of ornithological history at this institution, including triumphs and failures, passing personalities, and potentially lasting contributions. There were three primary periods of activity. The Early Period (1812–1869) featured the contributions of Alexander Wilson, Charles Bonaparte, John James Audubon, and John Cassin, plus many prominent associates—including Nuttall, Townsend, Gambel, Heerman, and Gould. Following a 20-year hiatus of ornithological inactivity, the Middle Period (1888–1969) featured the contributions of Witmer Stone, Rodolphe Meyer de Schauensee, and James Bond. The Current Period (1969–present) has featured the activities of university-trained, professional ornithologists. Each historical period differs from the others through its reflection of the evolution of the natural sciences in general and the personalities of the curators in particular. The nature of the ornithological research practiced also changed in many respects, except for the central role of specimens as a primary source of study in avian biology.

Two centuries ago, in the early 19th century, a small group of Philadelphians who shared a passion for local natural history met informally above an apothecary shop in the heart of the city. They particularly appreciated scientific discipline and taxonomic order as the basis for managing their discoveries of new plants and animals. To further their scholarly interests, six of these gentlemen founded the Academy of Natural Sciences in 1812 for the purpose of "obtaining, arranging, and preserving, in a suitable place . . . the many important periodical publications and scientific papers of the lettered world, with the requisite collections for

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[1] The Academy of Natural Sciences
Philadelphia, Pennsylvania 19103

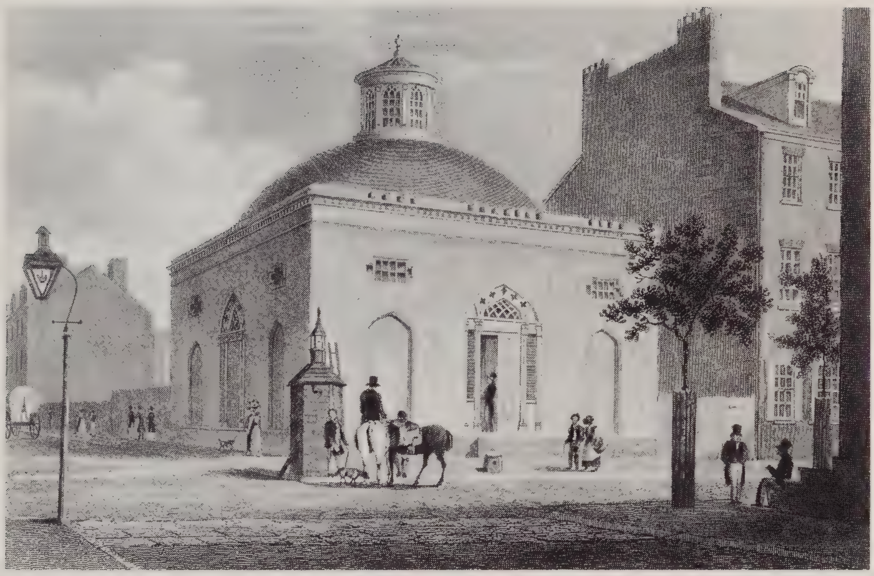

Fig. 1. An early home (1826–1840) of the Academy of Natural Sciences, Corner of Twelfth and Sansom Streets. Courtesy of the Academy of Natural Sciences of Philadelphia.

repeating notable experiments." Discussions of religion and politics were forbidden. Instead their common goal was "to form, constitute, and become a Society for the purpose of occupying their leisure . . . on subjects of Natural Science interesting and useful to the country and the world . . ." (Excerpts from the Academy of Natural Sciences of Philadelphia "Founders Document," from Peck 1985a). The programs of the new Academy were to complement those of the American Philosophical Society, founded in 1743, and the commercially-oriented Peale Museum, founded in 1784. Ornithology figured prominently among these programs from the beginning and would proceed through three well-defined periods of scientific activity: the Early Period, the Middle Period a 100 years later, and the Current Period.

Appendix I outlines important events in the Academy's history. The following pages detail many of these events.

THE EARLY PERIOD (1812–1869)

The first years of Philadelphia ornithology were extraordinary. The economic and political influence of the city of Philadelphia was at its peak in the late 1700s. The young nation was primed to establish its identity—socially, politically, and scientifically. The challenge of making an inventory of the native American biota attracted the attention of the first American naturalists. Birds were natural objects of initial study and Philadelphia ornithology grew quickly in prominence. Prior to the founding of the Academy of Natural Sciences, a list of 215 American bird species, including concise descriptions of each, had been compiled by Philadelphia naturalist William Bartram (1791). This effort shifted the scientific interest in our avifauna from European authors, especially Mark Catesby (1729–47), to local hands. The stage was set for more ambitious efforts.

Encouraged by William Bartram (1739–1823), Alexander Wilson, a Scottish immigrant, undertook to document fully the birds of an expanding country. He studied the growing collections at the Peale Museum (1786–1848) and added to them. Most of these collections were lost to fires that plagued the Peale Museum. Alexander Wilson published the first volume of *American Ornithology* in 1808, and seven more by April 1813. Ultimately nine volumes in length, Wilson's *American Ornithology* (1808–1814) became the foundation for all subsequent study of birds of North America. Alexander Wilson, however, did not live to participate fully in the life of the Academy of Natural Sciences of Philadelphia. After his death in 1813, George Ord, Vice-President of the Academy, oversaw the completion of *American Ornithology* and promoted the sales and influence of Wilson's work (Rhoads 1908).

In the ten years following Wilson's death, the Academy's reputation grew as rapidly as its collections. No other institution had comparable reference materials required for critical identification of new species, birds and non-birds alike. Through the first half of the 19th century, the Academy was North America's premier natural science institution. In 1856, Philip L. Sclater reported to the Zoological Society of London that the collections of the Academy generally, and the Department of Ornithology particularly, were superior to museums in Europe and therefore the "most perfect in existence" (Meyer de Schauensee 1957a). However, the Academy's leadership role did not last long after the Civil War. Upon the death of John Cassin in 1869, ornithological power followed the shift of political power from Philadelphia to Washington, D.C.

Alexander Wilson (1766–1813).—Alexander Wilson, the Father of American ornithology, started it all, fortuitously it seems in retrospect. Born in Scotland at Paisley Abbey on 6 July 1766, apprenticed as a weaver,

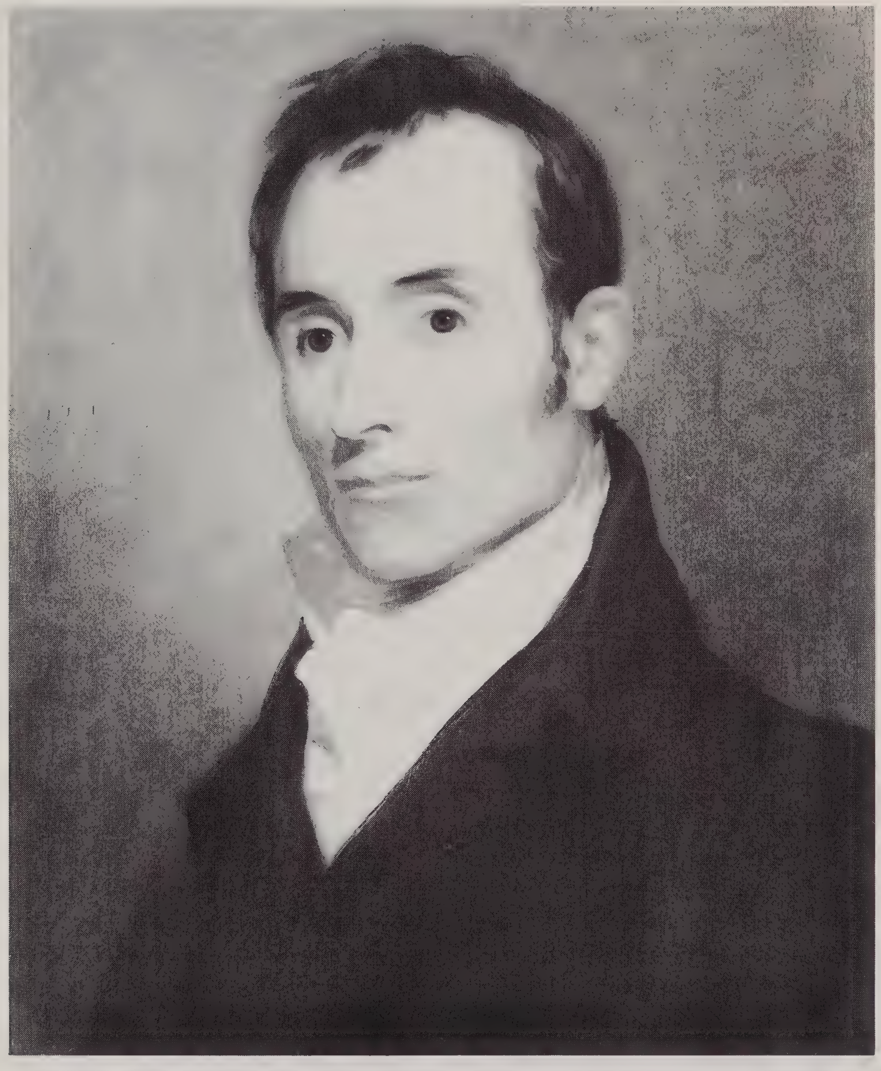

Fig. 2. Alexander Wilson (1766–1813), the Father of American Ornithology. Courtesy of the American Philosophical Society.

skilled as a wandering poet and musician, and jailed as a political rebel, he fled his homeland penniless in 1794 to find better fortune in America. He was then 28 years old. After seven uncertain years of wandering, temporary jobs, and at least one scandal with a married woman, he settled down as a schoolmaster at Gray's Ferry on the Schuylkill River in south Philadelphia. The political rebel still in his soul, he had already achieved some notoriety by writing a popular folk song "Jefferson and Liberty"

(Hunter 1983:3). It was at Gray's Ferry that his life finally came together. He met William Bartram, was captivated by the great naturalist's list of local birds, and with uncharacteristic determination wrote an old Paisley friend on 1 June 1803, "I am now about to make a collection of all our finest birds" (Hunter 1983:72).

Once the course was set, Wilson became an ornithologist possessed. He worked tirelessly for ten years, first studying local birds and improving his bird painting skills, then convincing publishers to undertake the financial risks of the work he envisioned. He subsequently secured enough private subscriptions to ensure financial success. Most importantly he coursed the forests, fields, and swamps throughout eastern North America in quest of new ornithological knowledge for his book. However, the stresses of wilderness expeditions and of the production of eight volumes in as many years took their toll. A weakened Alexander Wilson died on 23 August 1813 when he was unable to beat one more bout of severe dysentery, or "flux."

Elected to membership in the American Philosophical Society and the Academy of Natural Sciences shortly before his death, Wilson's reputation as the "Father of American Ornithology" was secure. The graphic depictions of 315 bird species and essays on 293 of them served as the fundamental reference for what was to follow.

Charles Lucien Bonaparte (1803–1857).—A nephew of the emperor Napoleon Bonaparte played a small but key role in the early history of the Academy of Natural Sciences, even though he moved from Europe to live with Napoleon's brother Joseph in Philadelphia for only about five years (1822–1827). The Bonaparte's Gull (*Larus philadelphia*) was named after this transient Philadelphia ornithologist, not his famous uncle. During his stay in America, Charles Bonaparte obtained an honorary degree from Princeton University and was active at the Academy of Natural Sciences. He was elected a member in 1824. Charles Bonaparte was highly regarded as one of the foremost ornithologists in North America. He devoted himself particularly to a four-volume continuation of *American Ornithology* (Bonaparte 1825–1833) with illustrations by Titian Peale of species and females not depicted by Wilson. He also met and became good friends with John James Audubon. Charles Bonaparte was especially interested in the systematics of birds, including both nomenclature and relationships. Indeed, he introduced the word "nomenclature" to ornithology, and placed American ornithology on the firm basis of science (Trotter 1905).

John James Audubon (1785–1851).—In the history of ornithology, Audubon was Wilson's natural successor, but with a different personal

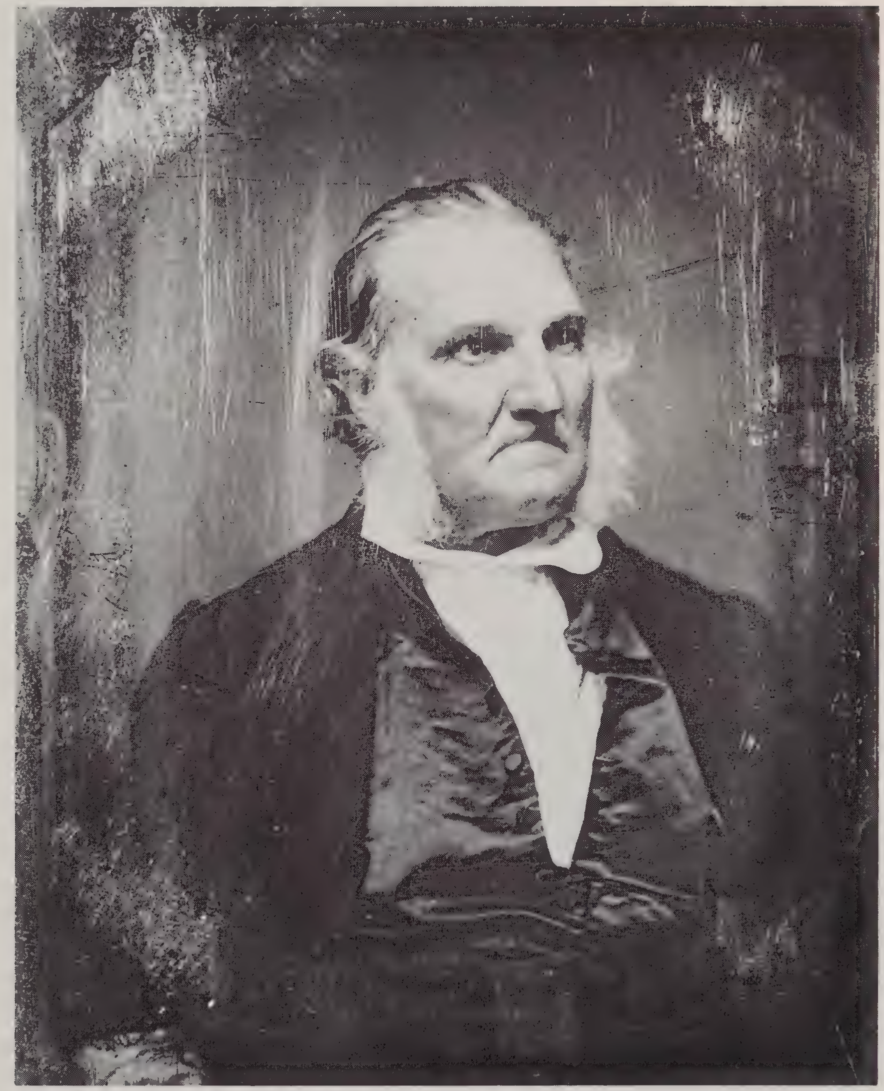

Fig. 3. John James Audubon (1785–1851) was the flamboyant outsider of the early period of Philadelphia ornithology. Twice denied membership in the Academy of Natural Sciences, he finally prevailed as the preeminent American ornithologist with the publication of *The Birds of America.* He was elected to membership in 1831. From a private collection, courtesy of Christie's.

style. Audubon was the most flamboyant and controversial figure of Philadelphia ornithology (Ford 1988, Peck 1985b,c). The son of a sea captain and his mistress who died soon after childbirth, John James Audubon was a difficult child, prone to tantrums and unwilling to accept his father's efforts to school him in France as an engineer. Instead, young Audubon was inclined towards hunting and fishing and most of all towards drawing French birds. His father, Jean Audubon, encouraged this artistic interest out of parental desperation. When both French society and his personal fortune were disintegrating, Jean Audubon sent his son to Philadelphia in 1803 to learn English and find a trade. Never at ease with the restrained Quaker life style of his father's business associates, he found renewed pleasure in the out-of-doors and in birds. Later, Audubon was inspired by *American Ornithology* to produce a book of his own bird paintings, which would be more ambitious and superior to Wilson's work.

Audubon first visited the Academy of Natural Sciences on 5 April 1824. He was invited by Charles Bonaparte, himself a newly elected member, who offered to introduce Audubon to his colleagues. Audubon had neither social nor ornithological credentials. He was received nevertheless in friendly fashion by all but Vice-President George Ord who viewed him as a potential rival who would negatively affect the sale of Wilson's *American Ornithology*. The opposite personalities of the two men quickly clashed: Ord was a polished and sophisticated aristocrat, Audubon an immodest and rough-spoken fellow who tactlessly started his presentation by criticizing Wilson's revered work. Twice Audubon was denied membership in the Academy because George Ord adamantly criticized the scientific accuracy of his paintings. Alexander Lawson, Philadelphia's top printmaker who engraved most of Wilson's plates, also rejected Audubon's "flawed" paintings. Eventually Audubon found a publishing partner in London. On his third try, in 1831, Audubon was accepted into the membership of the Academy. By this time there was no denying that Audubon's *The Birds of America* (1827–1838) would replace Wilson's *American Ornithology* (1808–1814) as the preeminent ornithological work. The new credibility that came with membership in the Academy helped to promote book sales. In addition, Audubon gained access to valuable specimens in the Academy's collections. The specimens of Nuttall and Townsend were of particular interest to Audubon, who had no personal experience with most western species.

> "In 1836 the great artist bought 93 duplicate [Nuttall and Townsend] bird skins from the Academy of Natural Sciences to serve as models for the plates of *The Birds of America*. 'Such beauties! Such rarities! Such Novelties!' he exulted in a letter to a friend. And so they were, among them the sharp-tailed and sage grouse, the dipper, rufous hummingbird, yellow-headed blackbird, mountain bluebird, valley or California quail, and varied thrush." (Peck 1991a:173).

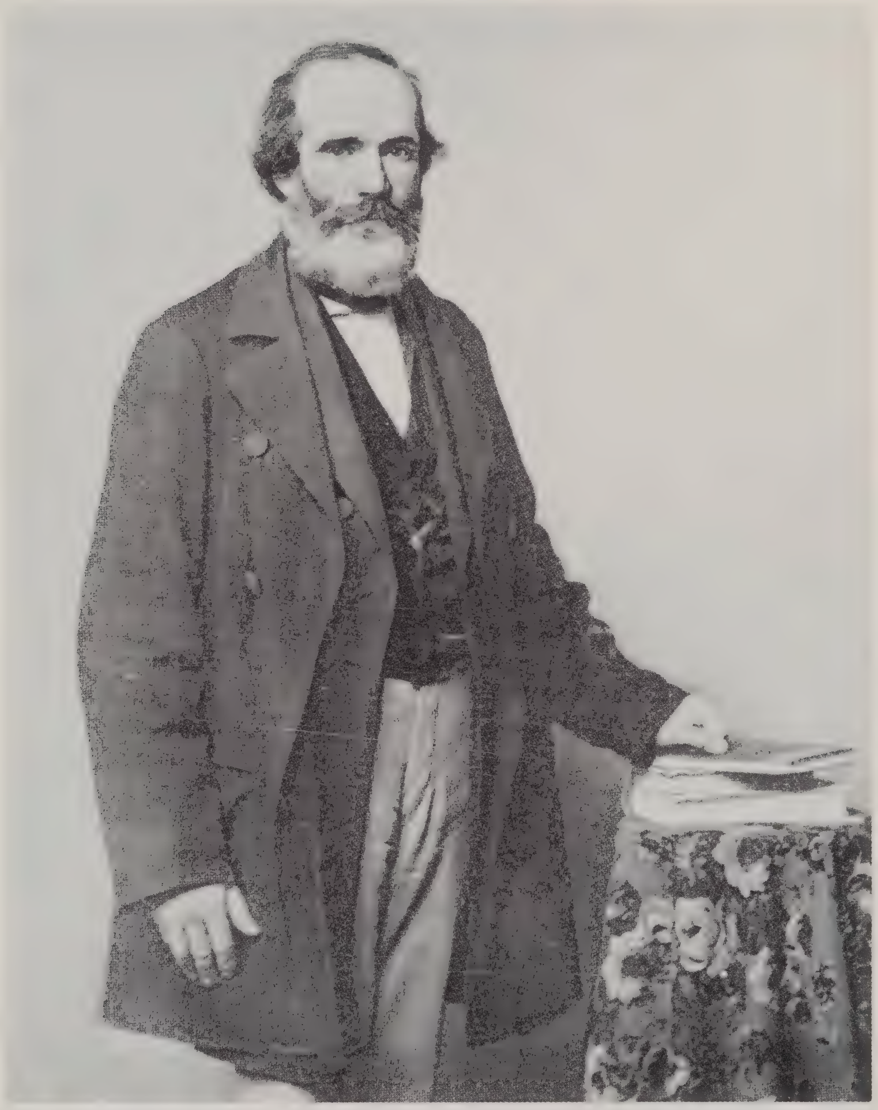

Fig. 4. John Cassin (1813–1869) reigned as Honorary Curator over the accessioning and description of the Academy's new collections including the world renowned Duc de Rivoli collection and John Gould's Australian collection. Courtesy of the Library of the Academy of Natural Sciences of Philadelphia.

John Cassin (1813–1869).—While Audubon's career was in full force, the Academy entered its first golden age of ornithological collections. In 1832, a wealthy doctor, Thomas Bellerby Wilson (1807–1865) was elected to membership in the Academy and ultimately assumed the role of President (Stone 1909). Wilson decided to purchase as many outstanding collections of natural history specimens as he could. Over a period of 30 years, he bought over 23,000 bird specimens, including such prizes as the the Duc de Rivoli Victor Massena's collection in 1846 and John Gould's Australian collection in 1847 (Meyer de Schauensee 1941, 1957b).

Presiding for 35 years over the ornithological benefits of the new bird collections at the Academy of Natural Sciences was John Cassin, a merchant in the import/export business (Peck 1991b). His office at the Custom House at Philadelphia's busy port on the Delaware River served him well as an intermediary for the international swapping and purchasing of new collections. His efforts were further enhanced by the unlimited financial backing of T. B. Wilson and by ready, choice cases of cognac or bolts of silk fabric from overseas. Ornithology was John Cassin's real interest and to this he devoted his evenings and weekends at the Academy of Natural Sciences. His hopes of a salaried appointment as Curator were never realized, but the Academy benefitted immensely from his volunteer labors as Honorary Curator.

John Cassin was born in Media, Pennsylvania, on 6 September 1813. His boyhood interests in science and natural history were nurtured at Westtown School, a Quaker boarding school which also nurtured naturalists Thomas Say, John Townsend, and Edward Cope. As a young man, John Cassin was the first to recognize that the seventeen-year cicada consisted of several different species, one of which was later named *Cicada cassini* in his honor (Peck 1991b). Formally ensconced as Honorary Curator in charge of the bird collections at the Academy in 1842, Cassin was interested initially in the birds of Africa and Europe, which were well represented in the newly acquired collections. After organizing these collections, he shifted his attention to the western United States.

John Cassin met John James Audubon only once—in the bird collection at the Academy in the spring of 1845 when the 60 year-old Audubon was nearing the end of his reign as the dean of American ornithology. The chance encounter was not entirely friendly and did not lead to a fruitful or mutually respectful relationship. The impromptu meeting quickly deteriorated into an argument over whether or not Audubon had been the first to name a new species of hawk (Harris' Hawk *Parabuteo unicinctus*) eight years before. "Audubon talked like a fool about it," recalled Cassin, who reveled in his superior knowledge of taxonomic literature. He reported dryly in a letter to a friend, "Audubon has been here. [I] do not particularly admire him—[he] is no naturalist—positively not, by nature" (Peck 1991b:I–3).

If Audubon was sometimes an insufferable boor, he had met his match in the art of condescension. John Cassin was in many respects an unhappy, bitter man with a sharp tongue that produced a lonely isolation. He was not entirely successful in marriage or business. He was openly hostile to "field" ornithologists, the very same collectors who provided his research specimens.

John Cassin's efforts to publish a work comparable to Audubon's *The Birds of America*, namely *Illustrations of the Birds of California, Texas, Oregon, British and Russian America* (1861), were less than satisfying (Peck 1991b). He strived to replace Audubon's romantic and artistic imprint on the field with new standards of taxonomic scholarship. Because he refused to compromise these standards, however, his sometimes dry and technical presentations of the species accounts never captured the public interest or the financial support his book required for popular success. Cassin also was hampered by poor health due to chronic arsenic poisoning from handling the dusty preserved bird specimens of the Rivoli collection. Ironically, the very same treasures that catalysed his ornithological prominence may also have brought about his premature death.

His troubles notwithstanding, John Cassin was a towering figure in the history of both Philadelphia and American ornithology. In his spare time, he described over 200 new species of birds. As an expert on the taxonomy and identification of birds of the world he had no peers in North America. Many new species were named in his honor including Cassin's Auklet (*Ptychoramphus aleuticus*), Cassin's Kingbird (*Tyrannus vociferans*), Cassin's Sparrow (*Aimophila cassinii*), and Cassin's Finch (*Carpodacus cassinii*). His self-taught scientific credentials earned him the greatest respect and friendship of the foremost scientists of his era, including Elliot Coues and especially Spencer Baird who would become his successors as the leaders of museum-based ornithology. Elliott Coues memorialized John Cassin in 1869:

> "The loss to science none of us can measure; nor can those privileged to call him friend adequately express the depth of that bereavement. And many as are our American ornithologists—high as some stand in American Ornithology—there is none left in all our land who can lift up the mantle that has fallen from his shoulders . . . Since Audubon passed away from the scene of his usefulness, death has struck no such cruel blow to our beloved science. As Dr. Brewer has said to me, 'Which one of our younger ornithologists will undertake to stand, after thirty-five years of training, where Cassin stood at his death?' " (Peck 1991b:I–33).

Philadelphia Ornithology did not recover from this loss for nearly 20 years—until Witmer Stone joined the Academy's staff and revitalized the Department of Ornithology.

THE MIDDLE PERIOD (1888–1969)

The Middle Period was a time of renaissance and transformation for ornithology in Philadelphia—as it was throughout the United States. A wave of professionalization in the natural sciences swept across the country. The American Ornithologists' Union, the Wilson Ornithological Society, and many others were founded. In the decades following the Civil War, ornithology emerged as an increasingly popular amateur pastime. In response to growing amateur interest there appeared a new set of regional bird clubs, such as the Delaware Valley Ornithological Club in Philadelphia, the Linnaean Society in New York City, and the Nuttall Ornithological Club in Cambridge, Massachusetts. They coincided also with the first major wave of popular environmentalism, a reaction to the commercial deforestation of the East, and to the slaughter of birds for com-

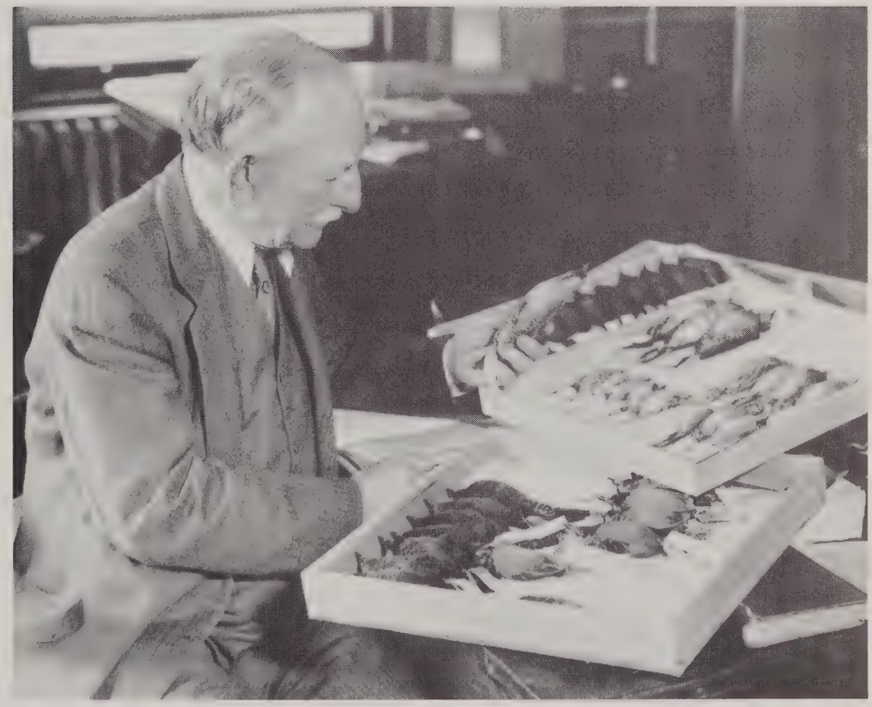

Fig. 5. Witmer Stone (1866–1939) oversaw the modernization of the collections and the popularization of ornithology at the Academy of Natural Sciences from 1888–1939. Courtesy of the Library of the Academy of Natural Sciences of Philadelphia.

mercial markets. Notable institutional responses included the founding of the National Audubon Society, the National Park Service, and the U.S. Fish and Wildlife Service.

Three distinguished ornithologists presided at the Academy of Natural Sciences during this period: Witmer Stone, Rodolphe Meyer de Schauensee, and James Bond.

Witmer Stone (1866–1939).—One of the central ornithological figures during these formative times was a witty, endearing Philadelphian named Witmer Stone. He served at the Academy of Natural Sciences for 50 years. Like his predecessor John Cassin, Witmer Stone was a blend of two strong Philadelphia stocks, English-Quaker and Pennsylvania Dutch. The personalities of the two men, however, could not have been more different. In contrast to John Cassin's often tactless, acerbic style, Witmer Stone had a "genius for friendship." He was revered by his colleagues inside and outside the Academy, as summarized by the introduction to James A. G. Rehn's (1941) memorial:

> "To a buoyant spirit he added an enthusiasm which he kept through life, a keen sense of humor, a touch of whimsey, a sympathetic understanding, a lover of good literature and the instincts of the historian and bibliophile, attributes all of which broadened his outlook upon the world and drew him closely to his fellow men."

Less than a year after he graduated with an A.B. degree from the University of Pennsylvania in 1887, Witmer Stone started his career at the Academy of Natural Sciences. Ornithology at the Academy was desperate for new leadership. The museums in Washington, New York, and Cambridge had all but eclipsed Philadelphia's role. The bird collection at the Academy remained virtually untouched since Cassin's time, mounted on white T-perch stands, crowded into glass display cases with historic type specimens unlabelled and dangerously exposed to light and dust. Witmer Stone located over 600 types of Gould, Cassin, Townsend, Audubon and others and rehoused them in better conditions. He converted the mounted specimens to flat study skins to enable more efficient storage and study. In 50 years Witmer Stone and his associates also increased the size of the collection five-fold.

Only two years after he started at the Academy, Witmer Stone and six friends founded the Delaware Valley Ornithological Club (DVOC) in 1890. One of the most active regional birding organizations, the DVOC was an integral part of his life, and he contributed substantially to its intellectual vigor:

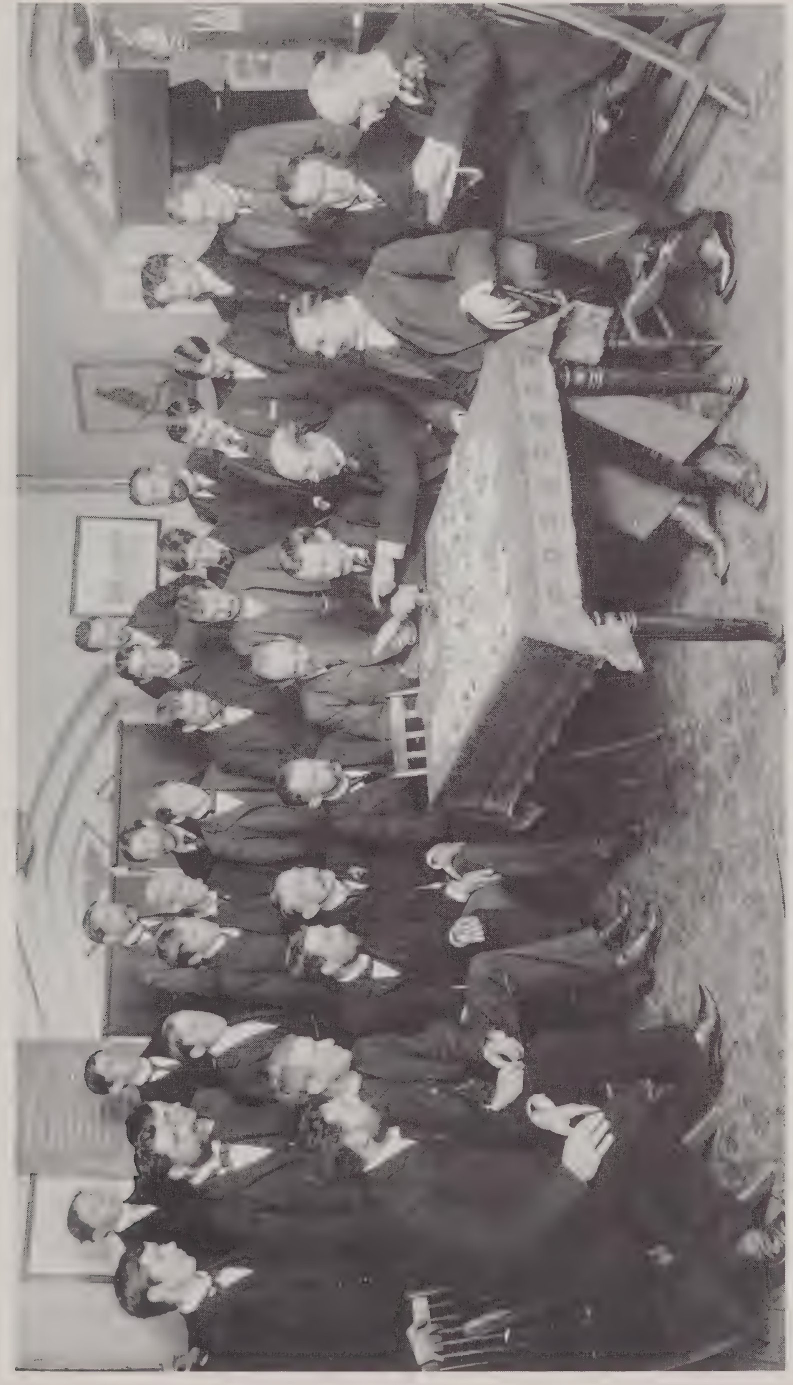

Fig. 6. Witmer Stone (seated center holding the specimen) helped to found and nurture the Delaware Valley Ornithology Club which met regularly in the Department of Ornithology. Courtesy of the Library of the Academy of Natural Sciences of Philadelphia.

> "Until failing health compelled him to limit his evening activities, for decades Witmer Stone gave to the meetings of the Club the value and pleasure of an association which its members . . . valued beyond expression. His broad knowledge, kindly comments, tactful suggestions and discerning advice were always welcomed, and he stood in the Club as the symbol of authoritative ornithology" (Rehn 1941:304).

The DVOC recently celebrated its Centennial (see Cassinia, Volume 63, 1990). For a century it has brought professional and amateur ornithology together in downtown Philadelphia at the Academy of Natural Sciences. Over the years the DVOC nurtured and was nurtured by prominent ornithologists including John Emlen and Joseph Hickey. The DVOC continues as one of Witmer Stone's primary legacies.

Witmer Stone also contributed his time to national organizations, especially the American Ornithologists' Union (AOU). He served as the AOU's Vice-President (1914–1920), President (1920–1923), Chairman of the Nomenclature Committee (1919–1931), Chairman of the Committee on Bird Protection (1896–1901), and most importantly as Editor of the Auk for 25 years (1911–1936). While he was Editor, Stone also wrote over 800 critical abstracts and reviews of the current literature as well as many obituaries of both American and foreign ornithologists. He also was a dedicated conservationist who served as President of the Pennsylvania Audubon Society and the National Association of Audubon Societies, and who spent much of his time from 1897–1903 with legislation to protect birds from exploitation for the millinery trade.

As a research ornithologist, Stone published over 95 papers prior to becoming Editor of the Auk in 1911. He was particularly interested in molts and plumages (see Stone 1896). Migration was another special interest, perhaps because he spent his summers at Cape May, New Jersey. His lifelong studies there led to the classic two-volume work *Bird Studies at Old Cape May* (1937) published by the DVOC shortly before his death. For this he received the AOU's Brewster Medal posthumously in 1939.

"Witmer Stone was born a naturalist, nurtured a naturalist, and a naturalist he lived until the end of his days. Most of the many activities that filled his busy life flowed from his profound interest in nature" (Rehn 1941:299). Birds were only one of Witmer Stone's many interests. He was also an expert botanist and general naturalist with substantial contributions to the mammalogy, entomology, arachnology, and botany of southern New Jersey.

During Witmer Stone's tenure at the Academy of Natural Sciences, two younger men started their own ornithological careers at the Academy. A mutual interest in birds and adventure drew Rodolphe Meyer de

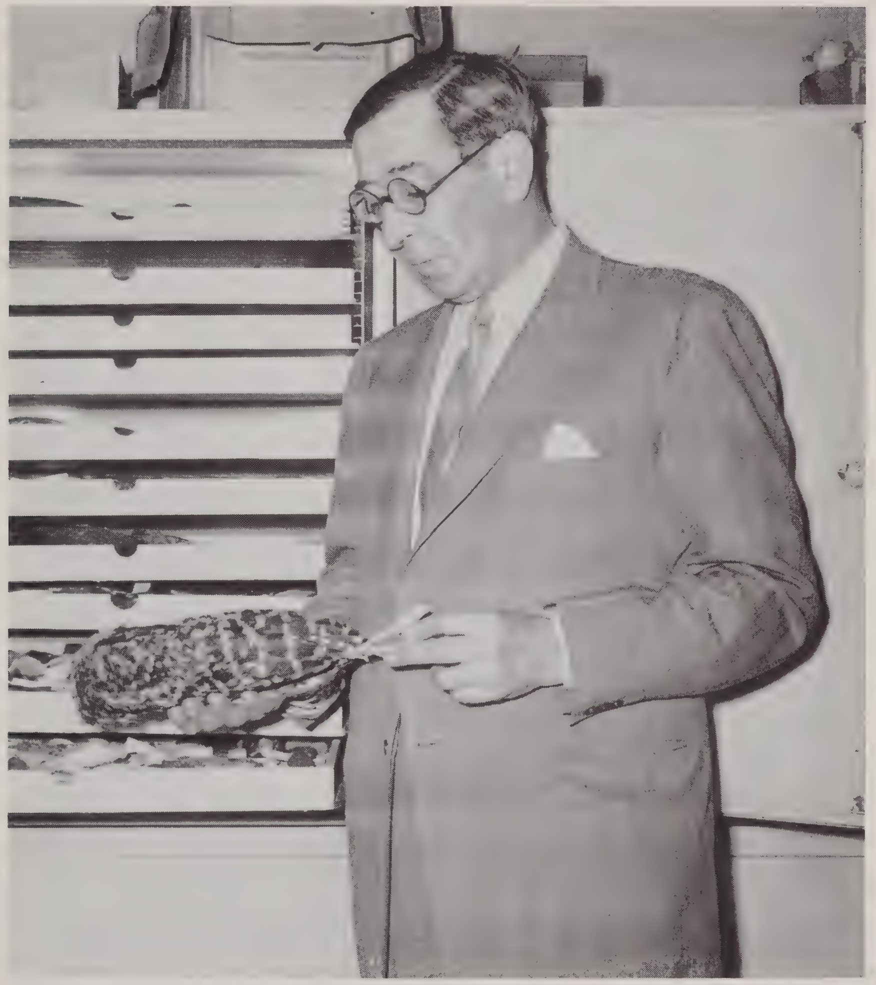

Fig. 7. Rodolphe Meyer de Schauensee (1901–1984) oversaw the acquisition of major collections from southeast Asia and from the Andes of South America. His comprehensive books on the birds of South America serve as the foundation for modern studies of that avifauna. Courtesy of the Library of the Academy of Natural Sciences of Philadelphia.

Schauensee and James Bond together and to the Academy when they were both in their mid-20s. Their interest in the birds of the world complemented Witmer Stone's attention to local natural history and served to revitalize the international role that Academy ornithology had enjoyed in the days of John Cassin. Starting their partnership together on a collecting trip

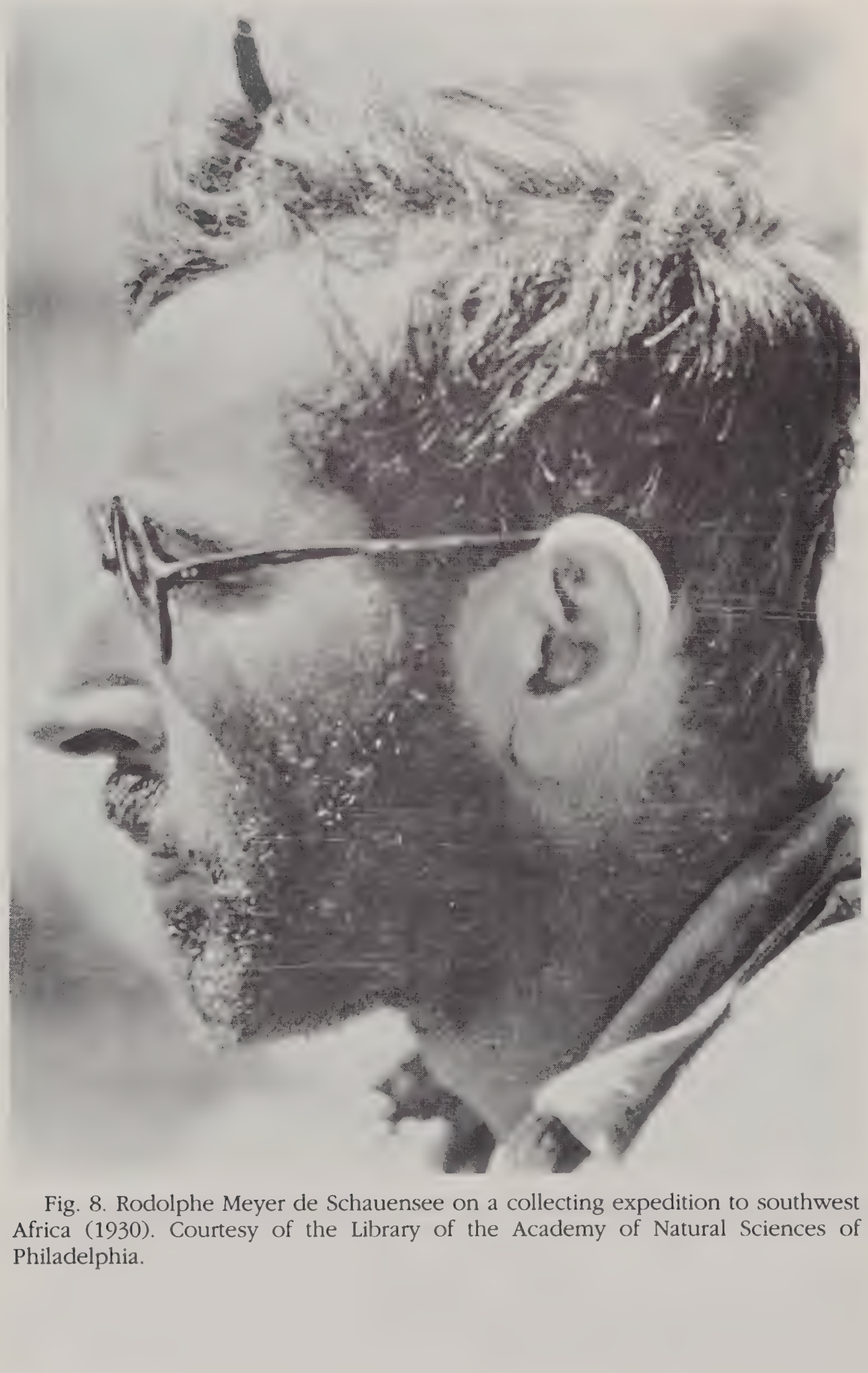

Fig. 8. Rodolphe Meyer de Schauensee on a collecting expedition to southwest Africa (1930). Courtesy of the Library of the Academy of Natural Sciences of Philadelphia.

to the Brazilian Amazon in 1926, these two men would represent Philadelphia ornithology for 30 or more years after the departure of Witmer Stone.

Rodolphe Meyer de Schauensee (1901–1984).—Rodolphe Meyer de Schauensee was a private, humble person who did not attend ornithological meetings or socialize in such professional circles. His life was a busy blend of extraordinary passions and hobbies. In addition to birds, he collected orchids, impressionist art, and 17th century French silver, all of which embellished his beautiful manor house in Devon, Pennsylvania. He was a champion backgammon player and spent much time with his wife at the race track. It was ornithology, however, which benefitted most from his prolific, scholarly writings—over 120 publications and six major books: *The Birds of the Republic of Colombia* (1948–1952); *The Birds of Colombia* (1964); *The Species of Birds of South America* (1966); *A Guide to the Birds of South America* (1970); *A Guide to the Birds of Venezuela* (with W. Phelps)(1978); and *The Birds of China* (1984).

Building the bird collections was one of Rodolphe Meyer de Schauensee's priorities at the Academy of Natural Sciences. Much of the growth achieved during Witmer Stone's tenure as Chairman was properly credited to his generosity. He financed collecting expeditions throughout the world, particularly in the Andes of Colombia, Peru, and Bolivia. With his support and through the efforts of Melvin Carriker and Kjell von Sneidern, the Academy amassed the world's largest collection of Andean birds. Meyer de Schauensee sponsored S. Dillon Ripley's first trip to New Guinea on the Academy's Dennison-Crockett expedition in 1937–38. He also did his own share of field work. His own expeditions with his wife Willimena took him to Siam (now Thailand) three times as well as to Burma, Bali, southwest Africa and Namibia, and Guatemala.

His modest retiring style hid from view Rodolphe Meyer de Schauensee's substantial European background—he was born in Rome the son of a Swiss baron, schooled in Rome, Florence, and later New York, and summered at the family chateau near Lucerne. In appearance Schloss Schauensee was a fairyland castle which was featured in several travel advertisements, to Rodolphe Meyer de Schauensee's delight. From those windows he had watched with childhood fascination the birds which ignited his interest in ornithology. He amassed an encyclopedic knowledge of the ornithological literature, made possible in part by his fluency in Italian, French, and Portuguese. In person he was a warm and generous fatherly associate who liked to be called "Rudy," which circumvented the formidable obstacles of his full name. His last name was properly "Meyer de Schauensee," not "DeSchauensee" as it was often abbreviated by Rodolphe

Meyer de Schauensee himself. He prepared the foundations for modern study of the complicated avifauna of South America, much as Wilson had done in his time for North America. For that achievement Rodolphe Meyer de Schauensee received the Brewster Medal of the American Ornithologists' Union in 1977 (Anon. 1977).

Although Rodolphe Meyer de Schauensee is perhaps best known for his contributions to South American ornithology, the birds of southeast Asia were his deepest interest, stemming from his early days in Thailand. *The Birds of China* (1984) was the work that he most wanted to complete. His failing health made this effort difficult, but with determination he finished it. He died two weeks after it was published.

James Bond (1900–1989).—Also shy, but equally charming and accomplished, was the Academy's and the world's leading expert on the

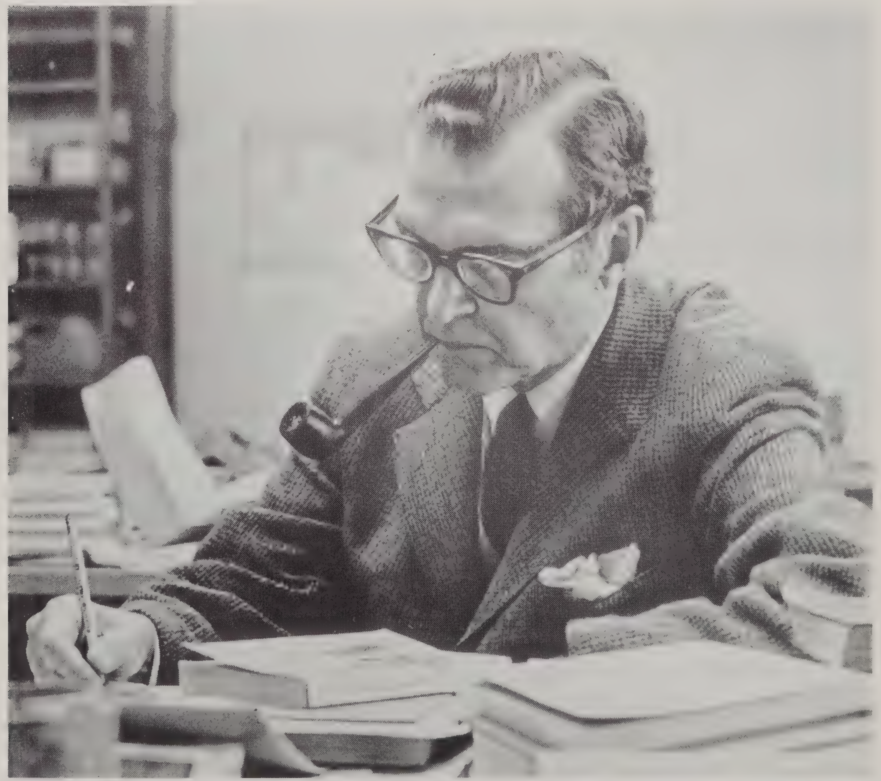

Fig. 9. James Bond (1900–1989) devoted his life to the birds of the West Indies, including their biogeographical origins. Courtesy of the Library of the Academy of Natural Sciences of Philadelphia.

birds of the West Indies, James Bond. James Bond was born and raised in Philadelphia. He was educated in England. Early exposures to nature, including insect and egg collecting at his father's country estate in Gwynedd Valley, Pennsylvania, and on the Maine coast in the summer, built his expertise as a naturalist and his fascination with islands. It was the birds of the West Indies that caught his interest as a young man. To them he devoted his ornithological career. The Harvard naturalist, Thomas Barbour wrote in *Cuban Ornithology* (1943:5):

> "The most noteworthy event in Cuban ornithology . . . was the decision of James Bond of Philadelphia to devote himself to the study of the birds of the West Indies. A peerless observer and a person possessed of great charm and manner, he naturally made himself welcome far and wide. Feeling that less collecting and more observing of birds was the need of Antillean ornithology, he devoted himself in a leisurely way to studying the abundance, breeding habits, and distribution of the birds of the Antilles, so that now he may rest sure of the knowledge that no one has ever lived who has seen as many Antillean birds as he has, or seen them as intimately."

Beyond his monographic works on the systematics of the birds of the West Indies, James Bond realized that his studies had profound biogeographical implications. He concluded that most of the island taxa were derived not from species in South America but instead from members of the original North American avifauna. His papers on the North American origins of the bird fauna of the West Indies (Bond 1934, 1948, 1963) thus challenged prevailing ideas. For this and related contributions he was awarded the AOU's Brewster Medal in 1954, and was honored by the designation of "Bond's Line" by David Lack (1976) to demark the Antillean avifauna from the neotropical avifauna of adjacent South America.

James Bond continued an active correspondence, regular publication of supplements to the *Check-list of the Birds of the West Indies* (1956), and revisions of his field guide (1947) for 15 years after he nearly lost his life to cancer in 1974. In addition to his field guides, he contributed over 100 papers to the ornithological literature including many on the birds of South America. Despite pain and inconveniences during his final years, he was always eager to debate fine points about the systematics of birds, especially in the late afternoon with a glass of sherry or scotch. To the end he maintained his interest in avian life histories and a conviction that the nests and eggs of birds deserved more attention by the new generation of ornithologists because they provided critical phylogenetic information.

That the real James Bond's reputation was sometimes overpowered by Ian Fleming's fictional superhero was not a coincidence. Fleming was

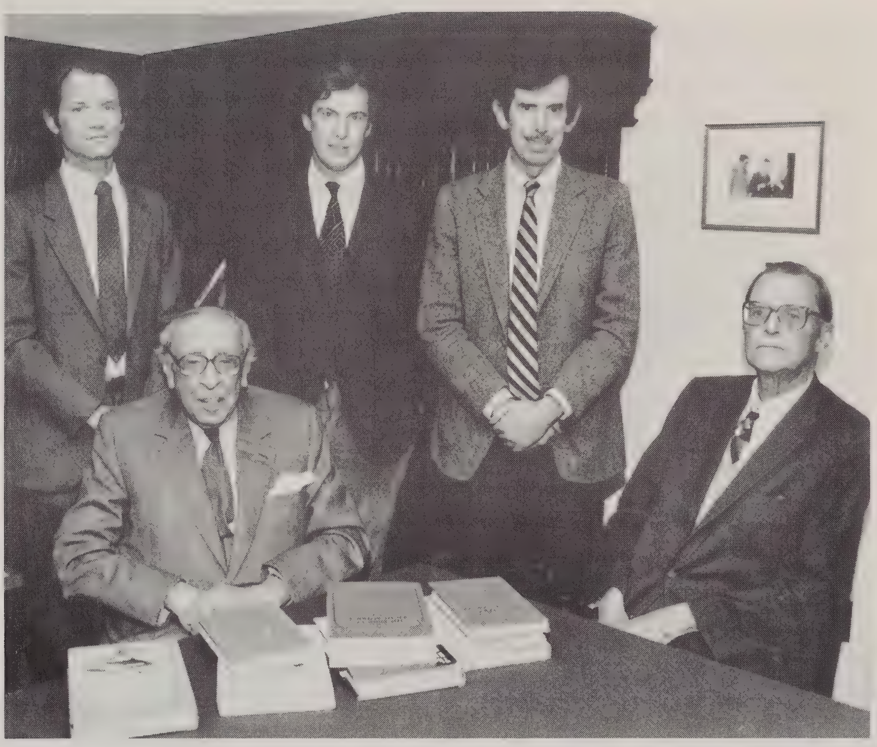

Fig. 10. The transition to new university trained staff in the Department of Ornithology (1983). From left to right: J. Peterson Myers, Rodolphe Meyer de Schauensee, Robert S. Ridgely, Frank B. Gill, and James Bond. Courtesy of the Library of the Academy of Natural Sciences of Philadelphia.

an enthusiastic birdwatcher who maintained a residence on Jamaica. The name of the author of a field guide to the local birds caught his eye at a critical moment when he was contemplating a name for his character. There followed many a confusion, all to the embarrassment of the real James Bond. A bachelor for over 50 years, he married Mary Wickham Bond in 1953 and tolerated with much devotion her commitments to his written biography, including *How 007 Got His Name* (1966), *Far Afield in the Caribbean* (1971), and *To James Bond with Love* (1980).

THE CURRENT PERIOD (1969–PRESENT)

James Bond and Rodolphe Meyer de Schauensee oversaw the end of the second period of Philadelphia ornithology practiced by self-trained gentlemen, some of means and leisure. Ornithology itself was a science in transition from description, cataloging, and nomenclature to synthesis of faunistics, biogeography, and evolutionary biology. Also changing was the expected training of museum ornithologists. In truth, the Academy of Natural Sciences lagged behind its sister institutions in the recruitment of young university-trained scientists. But in the late 1960s, the Board of Trustees of the Academy decided to revitalize its scientific staff with appointments in Malacology, Entomology, Limnology, and Ornithology.

The Current Period of Philadelphia ornithology is only a quarter century old. It is still too soon to put such recent activities into a perspective comparable to those of the Early and Middle periods. Here I try to summarize some of the key efforts which provide a sense of continuity in the Academy's Department of Ornithology.

Frank B. Gill (1941–).—When the formal retirements of James Bond and Rodolphe Meyer de Schauensee became imminent in the late 1960s, the Academy appointed Frank Gill as an Assistant Curator of Ornithology. Gill had just graduated with a doctorate from the University of Michigan. His interests in island birds complemented those of James Bond. Born on 2 October 1941, in New York City, inspired to watch birds by his grandfather, Frank Rockingham Downing, and nurtured in natural history by the Hackensack (New Jersey) Audubon Society, Urner Ornithological Club, and National Audubon Society, Gill was trained by Robert W. Storer and Harrison B. Tordoff at the University of Michigan Museum of Zoology, and by Wesley E. Lanyon at the American Museum of Natural History. He became Chairman of the Department of Ornithology in 1970 and Director of the Division of Systematics and Evolutionary Biology in 1973.

Stalled by difficult financial years in the early 1970s, the Academy began to prosper with the recruitment of President Thomas Peter Bennett in 1976. Gill then resigned from his general administrative responsibilities in 1978 in order to devote more time to the Department of Ornithology. The department was well-positioned for growth because the Academy had completed renovations of its space, and the collections were housed in a new system of compactors, the first ornithological collection in the country to be "compactorized" and also "computerized." New department projects included the launching of Visual Resources for Ornithology—VIREO (see below), the recruitment of a vigorous department staff, starting with the appointment of J. P. Myers, a student of Frank A. Pitelka, and Gill's writing of the text *Ornithology* (1989). The department prospered also with the strong support of the Academy administration and outside friends. Internally the department grew to occupy a leadership position with respect to staff size, grants, and public relations. Externally the department achieved more notice with the production of 121 publications including three new books from 1980 to 1989.

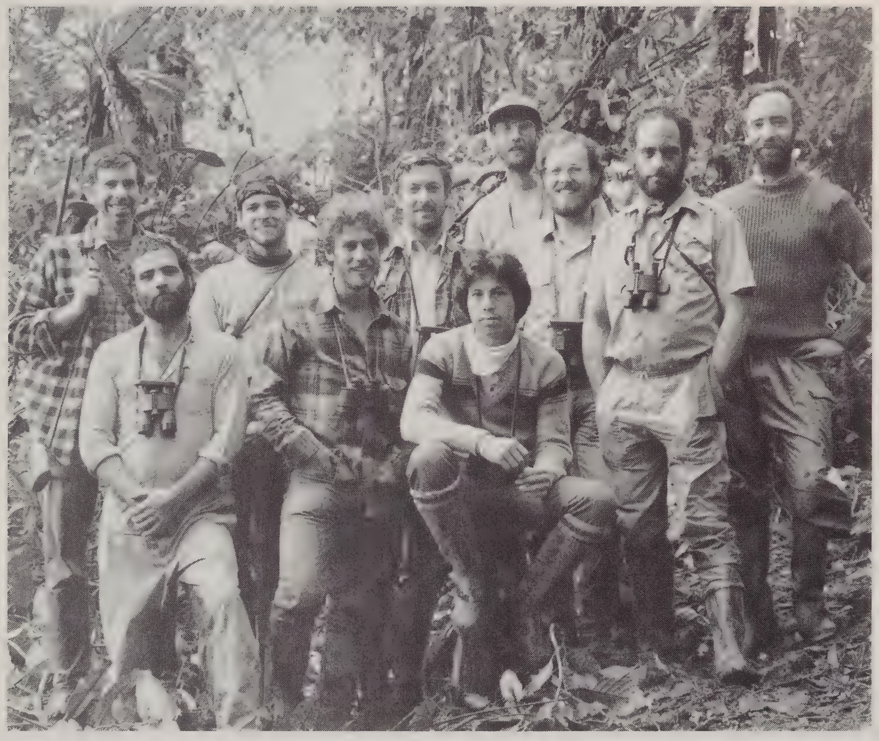

Fig. 11. Participants on the Academy's expedition to the Cordillera del Cutucú in southwestern Ecuador (1984). From left to right: Frank Gill, Paul Greenfield, George "Skip" Glen, Todd Miller, Robert Ridgely, Mark Robbins (rear), Juan José Espinosa (front), Tom Schulenberg, Steve Greenfield, and Robert Peck.

Courtesy of the Library of the Academy of Natural Sciences of Philadelphia.

Collections.—In 1978 Gill decided to assemble and build a collection of ornithological photographs that would receive the same curatorial commitment as traditional specimens. Supported by pioneering hummingbird photographer Crawford H. Greenewalt, VIREO became a unique international program for the archival storage of scientifically curated bird photographs (Kaufman 1991, Myers et al. 1986). Promoted brilliantly by Myers, the collection of 70,000 selected images now includes over 5000 species, roughly half of the world's birds. Acquired were the photograph collections of Crawford Greenewalt, Eliot Porter, Victor Hasselblad, and John Dunning, plus contributions by over 390 photographers. Three full-time staff respond to the requests of ornithologists, conservationists, teachers, and publishers worldwide. VIREO photography is now a formal component of the department's modern expedition program.

During the 1970s and especially the 1980s, the bird collections once again expanded through acquisitions from expeditions and research programs. The rate of collection growth hardly matched that achieved by the efforts of Witmer Stone and Rodolphe Meyer de Schauensee, but over 9000 specimens have been added since 1980. The collection now totals 163,000 study skins. Also routinely preserved are frozen tissues of local and tropical birds for biochemical studies. Comparisons of DNA to define evolutionary relationships are a major part of the department's modern research program.

The department continues its historical strengths in faunistics and biogeography with a special focus on the birds of South America. Following completion of his graduate work at Yale University, Robert S. Ridgely, author of *The Birds of Panama* (1976) joined the department in late 1982 to begin writing a four-volume illustrated treatise on *The Birds of South America* with artist Guy Tudor. The department's extensive collections of specimens from the Andes and of photographs of living birds from the continent were precisely the resources that Ridgely and Tudor needed for this effort. The first volume (oscine passerines) (Ridgely and Tudor 1989) and the second volume (suboscine passerines) (Ridgely and Tudor 1994) are now available.

Since 1984 Ridgely and Mark Robbins, the department Collection Manager, have organized regular collecting expeditions to South America, especially to Ecuador in collaboration with the Museo Ecuatoriano de Ciencias Naturales in Quito. These expeditions complemented and extended Meyer de Schauensee's previous efforts. One of the most exciting discoveries was the new parrot *Pyrrhura orcesi*, which they named after Ecuador's leading naturalist, Gustavo Orces (Ridgely and Robbins 1988). The end product of this project will be a field guide to the birds of Ecuador authored by Ridgely and his artist colleague Paul Greenfield.

In addition to the birds of South America, the Academy's collections are rich in specimens from southeast Asia. Extending that tradition are the research interests of Frederick H. Sheldon, who joined the department in 1987 following Myers' departure to the National Audubon Society. Three years of field work on Borneo had already established Sheldon as a ranking American expert on the birds of that large island. A student of Charles G. Sibley, Sheldon combines interests in biochemical systematics, higher category relationships among birds, and the biogeography of the faunas of the Sunda Islands. In fitting tribute to James Bond, Sheldon's studies of swallow DNA in collaboration with David Winkler at Cornell University (Winkler and Sheldon 1993) bear out Bond's analysis of relationships among genera based on nest structure (Mayr and Bond 1943).

Conservation.—Department staff continue to pioneer contributions to wildlife conservation. Two unique efforts merit special mention. First, J. P. Myers championed the protection of staging areas of migratory shorebirds. Using the springtime gathering of Sanderlings (*Calidris alba*) on the shores of the Delaware Bay as a rallying point for public concern, he galvanized political and financial support for the Western Hemisphere Shorebird Reserve Network (WHSRN), which now thrives as a model of international cooperation for the conservation of migratory birds. In a parallel success story, Robert Ridgely guided the redirection of the action-oriented programs of the organization RARE, based at the Academy for five years (1987–1991), towards tropical bird conservation. RARE's Caribbean initiatives program is now a model for saving endangered parrots and the forests on which they depend, by rallying public, grass roots interest in short-term campaigns.

State ornithology.—The largest department project in this context has been management of the Pennsylvania Breeding Bird Atlas from 1983 to 1988. In partnership with the Pennsylvania Game Commission, six years of field work by more than 2000 volunteers raised our knowledge of the distribution and abundance of Pennsylvania breeding birds to a new level (Brauning 1992). Atlasers visited 4928 "blocks" to document the presence of 187 breeding species and then compiled the data into comprehensive maps for the Commonwealth. In addition to enhancement of ornithological knowledge, the atlas project brought amateur and professional ornithologists from throughout the state together as never before, and stimulated the founding of the Pennsylvania Society for Ornithology in 1989.

The past as prologue.—In 1976, the Academy received an important assist in interpreting its own history with the arrival on staff of Robert McCracken Peck, a Philadelphia-born naturalist with historical and art historical training from Princeton and the Winterthur Program at the University of Delaware. Through Peck's efforts, the ornithological art collections expanded in size and stature with the acquisition (through long term loan or gift) of a large number of original works by Louis Agassiz Fuertes, Allan Brooks, Ernest Thompson Seton, Terence Shortt, Don Eckelberry, and Robert Verity Clem, among others. In 1982, Peck organized the first full-scale museum exhibition of the art of Louis Agassiz Fuertes, parts of which travelled to natural history museums across the United States. His biography of Fuertes, *A Celebration of Birds: The Life and Art of Louis Agassiz Fuertes* (1982) was published in conjunction with the exhibition. Peck's publications on other prominent figures in the history of ornithology have included biographical essays on William Bartram (1980), John James Audubon (1985a), John Cassin (1991b), Terrence Shortt (1987), and Robert Mengel (1991c).

Also bringing the department's history full circle is a new effort entitled *The Birds of North America* (BNA). In partnership with the American Ornithologists' Union, the Academy will publish authoritative modern accounts of our current knowledge of each species of North American birds. These accounts will replace the 50-year-old accounts of Arthur Cleveland Bent's "Life Histories." The BNA species accounts are intended to catalyze additional research by both professionals and amateurs as well as to enable sound management of our native birds by government agencies and conservation organizations. The similarities in concept, administration, and financial planning to Wilson's *American Ornithology* have only just become apparent with the writing of this historical retrospective.

In conclusion, ornithology in Philadelphia has centered at the Academy of Natural Sciences for the better part of 200 years. The principal characters involved, each a distinctive personality, have contributed energetically and prolifically to ornithology. There is an historical tendency in Philadelphia Ornithology to undertake courageous projects, some of which—*American Ornithology, The Birds of America*—proved to be milestones in the early development of our science. The legacy of our history and the courage of our predecessors are truly humbling. It was a fitting tribute to them that the Wilson Ornithological Society chose the Academy of Natural Sciences to host its Centennial Meeting in 1988. On that occasion some of us visited Alexander Wilson's grave at Old Swede's Gloria Dei churchyard and vowed to do our best to continue the work he started almost two centuries ago.

ACKNOWLEDGMENTS

Christine Bush, Margaret Fischer, Robert M. Peck, Mark B. Robbins, and Karen Stevens helped to insure the accuracy of this essay. I greatly appreciate their assistance. The errors that remain are mine.

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APPENDIX I

A Summary of the History of Ornithology at The Academy of Natural Sciences of Philadelphia

The Early Period

1812	Academy of Natural Sciences founded.
	William Bartram and Alexander Wilson elected to membership.
1814	Publication of ninth and final volume of Wilson's *American Ornithology.*
1815	Recorded history of collection begins; J. Coates presents Bird of Paradise.
1817	Publication of first paper on birds by a member of Academy: George Ord reports capture of Glossy Ibis at Great Egg Harbor, New Jersey.
	Thomas Nuttall (1786–1859) elected a corresponding member of the Academy.
1822	Recognition of Academy in Europe: Professor Bonelli of Turin presents 12 specimens of Italian birds.
1824	Charles Lucien Bonaparte (1803–1857), nephew of Napoleon, elected a member of the Academy.
	John James Audubon (1785–1851) first visits the Academy, seeking support for his projected book on birds.
	Charles Jacob Temminck (1770–1858) elected a corresponding member of the Academy.
1825–33	Publication of C. L. Bonaparte's *American Ornithology.*
1827–38	Publication of J. J. Audubon's *The Birds of America.*
1830	First significant bird collection acquired: Dr. Marmaduke Burrough presents 109 skins of Indian birds.
1831	John James Audubon elected a corresponding member of the Academy.
1832	Thomas Bellerby Wilson (1807-1865) elected a member of the Academy. Buys major European collections which established ANSP's reputation.
1833	John Kirk Townsend (1809–1851) elected a member of the Academy.
1835	Edward Harris (1799–1863) elected a member of the Academy.
1839	William Gambel (1819–1849) based at the Academy before leaving on first expedition to the far-west in 1841. Elected to membership in 1843.

1842	John Cassin (1813–1869) joins the Academy as honorary curator of birds.
	Spencer Fullerton Baird (1823–1887) elected a corresponding member of the Academy.
1843	John Gould elected a corresponding member of the Academy.
1845	Adolphus L. Heermann (1818–1865) elected a member of the Academy. He served as surgeon and naturalist on the Pacific Railroad Survey.
1846	The Academy's bird collections achieve international recognition with the acquisition of the first installment of the Rivoli collection (12,500 specimens).
1847	Ornithological collections grow by 8000 specimens with the addition of collections by Bourcier, Gambel, Cassin, Temminck, and John Gould's Australian collection.
1848–49	Collections of John James Audubon and Edward Harris including many of Audubon's types acquired. The second installment of the Rivoli collection arrives.
1856	Dr. P. L. Sclater reports to the Zoological Society of London that the collections of the Academy generally and the Department of Ornithology particularly are probably superior to those in any museum in Europe and are therefore "the most perfect in existence."
1857	Gould visits America, the Academy, and sees his first living hummingbird (in Bartram's garden).
1863	Thomas Wilson resigns as President of the Academy because his sympathies with the South put him in conflict with his Academy colleagues who favored the Union cause. He died two years later of typhoid fever.
1869	John Cassin dies of arsenic poisoning from the specimens in the collection, closing the first great period of the Academy's Department of Ornithology.

The Middle Period

1888	Witmer Stone joins the Academy as a Jessup Fund student and began to catalog the collection neglected since Cassin's death.
1890	Delaware Valley Ornithological Club founded.
1891	Collection starts to grow again with new acquisitions, including Robert Peary's North Greenland collections.
1897	Renovation of collection completed; Witmer Stone becomes President of AOU.
1926	James Bond and Rodophe Meyer de Schauensee begin their lifelong association with the Academy by making a collection of 506 birds near Belem, Brasil.

1927	James Bond starts life's work in the West Indies with a collecting trip to the Lesser Antilles.
1928–38	Rodolphe Meyer de Schauensee leads expeditions to Siam.
1934	Publication of *The Distribution and Origin of the West Indian Avifauna* by James Bond.
1935	Academy produces nation's first public museum exhibition on the life of John James Audubon.
1936	Publication of *Field Guide to Birds of the West Indies* (First edition) by James Bond.
	J. Fletcher Street rescues and presents to the Academy 321 Audubon/Harris specimens collected on the Missouri River in 1843. These were being used by boys for target practice on a farm in New Jersey.
1938	Publication of *Bird Studies at Old Cape May* by Witmer Stone, who dies later that same year.
1948	Rodolphe Meyer de Schauensee begins survey of the birds of Colombia.
1954	James Bond awarded American Ornithologists' Union's Brewster Medal.
1964	Publication of the *Birds of Colombia* by Rodolphe Meyer de Schauensee.

The Current Period

1969	Frank Gill joins the Academy's scientific staff. He is appointed Chairman of the Department of Ornithology the following year.
1970	Publication of the *Birds of South America* by Rodolphe Meyer de Schauensee.
1973–79	Academy receives grants from the National Science Foundation to rehouse collection in compactors and to computerize specimen data.
1975	Academy hosts Caribbean Biogeography symposium honoring James Bond.
1976	Academy hosts annual meeting of the American Ornithologists' Union at Haverford College.
1977	Robert McCracken Peck joins staff of the Academy; Appointed Fellow of the Academy in 1983.
1978	Rodolphe Meyer de Schauensee awarded American Ornithologists' Union's Brewster Medal.
	Publication of *Birds of Venezuela* by Rodolphe Meyer de Schauensee and W. Phelps.
1979	Visual Resources for Ornithology (VIREO) established.
1982	Robert S. Ridgely joins the Department of Ornithology.

1983	Publication of *A Celebration of Birds: The Life and Art of Louis Agassiz Fuertes*, by Robert M. Peck.
	John Peterson Myers joins Academy's scientific staff; founded Western Hemisphere Shorebird Reserve Network before moving to National Audubon Society in 1986.
1983–88	Pennsylvania Breeding Bird Atlas, directed by Frank B. Gill and Daniel Brauning, was based at the Academy.
1984	Academy starts *Birds of Ecuador* project.
	Publication of *Birds of China* by Rodolphe Meyer de Schauensee, who dies two weeks later.
1987	Frederick H. Sheldon joins Academy's scientific staff. Moved to Louisiana State University in 1994.
1988	Academy hosts Centennial Meeting of Wilson Ornithological Society.
1989	James Bond dies after battling cancer for 15 years.
	Publication of *The Birds of South America*, Vol I (Oscine Passerines) by Robert S. Ridgely and Guy Tudor.
	Publication of *Ornithology*, by Frank B. Gill.
1990	Publication of *Land of the Eagle: A Natural History of North America* by Robert M. Peck. Remains on Best Seller List in Great Britain for nine weeks; reaches #3 in April 1990.
1991	*The Birds of North America* launched in partnership with the American Ornithologists' Union.
1992	Publication of the *Birds of Missouri* by Mark B. Robbins and D. A. Easterla.
	Publication of *Atlas of Breeding Birds in Pennsylvania* by Daniel Brauning.
1994	Publication of *The Birds of South America*, Vol II (Suboscine Passerines) by Robert S. Ridgely and Guy Tudor.
	Publication of *Ornithology*, second edition by Frank B. Gill.

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Ornithology at the U.S. National Museum of Natural History

Richard C. Banks[1]

ABSTRACT.—The Smithsonian Institution was created in 1846; the United States National Museum (USNM) was established as part of it in 1859. Two groups of ornithologists—one with the Smithsonian/Museum and one with the Bureau of Biological Survey—have been involved in the growth and development of the National Museum's world-wide bird collections, which number about 600,000 specimens. The work of USNM scientists such as Spencer F. Baird, Robert Ridgway, Alexander Wetmore, C. Hart Merriam, and many others has had a major impact on the development of ornithology in North America.

The history of ornithology at the United States National Museum of Natural History (USNM) incorporates the histories of two groups of individuals, the staff and associates of the Smithsonian Institution, of which the Museum is a bureau, and the staff of the Bureau of Biological Survey (later part of the U.S. Fish and Wildlife Service, but as of late 1993 part of the National Biological Survey), who cooperatively care for and study the museum's bird collections. The history also concerns the growth and development of the collections, the people who made the collections, and the literature that deals with the study of the collections. Such a history is not a thread extending from somewhere in the past to the present, but a web stretching out to snare items of interest to be incorporated into it.

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ORIGINS

The Smithsonian Institution was created by an act of Congress in 1846 to implement the will of the English chemist and mineralogist James Smithson, who bequeathed his fortune to the United States to found "an establishment for the increase and diffusion of knowledge among men." Joseph Henry, the first Secretary of the Institution, wanted to support research and publication, but not to develop collections or have a public museum. Some three years later, Henry hired Spencer F. Baird to be his Assistant. Baird was a prodigious collector, and a master of persuading others to collect for him (Yochelson 1985). Baird's personal collection of some 3600 birds, which included some given to him by John J. Audubon, followed him to Washington in 1850 (Herber 1963:6–8).

The federal government already had some collections of natural history material when the Smithsonian was founded. The U.S. Exploring Expedition (USEE), often known as the Wilkes Expedition, sailed for South America and the Pacific in 1838 (Viola and Margolis 1985) with Titian R. Peale and Charles Pickering as naturalists. Secretary of War Joel Poinsett felt strongly that material returned by the expedition should remain in Washington under government control rather than be given to private institutions as material from past (e.g., Lewis and Clark) expeditions had been. Poinsett and others, including Col. John J. Abert of the Army Corps of Engineers and father of Lt. James W. Abert, organized the National Institution for the Promotion of Science in 1840 and suggested that the organization care for the USEE material (Evelyn 1985). In 1841 an appropriation of $5000 was made to the navy to facilitate the shipment of some boxes of USEE material to Washington and the care of the material by the National Institution. The collections were housed in the newly constructed Patent Office Building. Material from other sources, including the War Department and some private collections, was also housed at the National Institution. Peale's bird specimens (Peale 1848) were the first major collection of exotic species to reach the United States (Watson 1985). Increasingly large shipments of USEE material and the resultant demand for space led to conflicts between Poinsett and Patent Commissioner Henry Ellsworth, who pointed out that the National Institution was a private organization that had no right to occupy federal space or to care for government collections. Many of the early USEE specimens were poorly treated by National Institution staff, and Peale later complained of the loss of some of the birds and mammals he had collected. On the return of the USEE in 1842, Pickering was made Curator of the collections and their control by the National Institution ended.

Apparently swayed by Baird, Secretary Henry made certain that federal money beyond that generated by the Smithson bequest would be available for the maintenance of collections, and in 1857 Congress first appropriated funds for that purpose. The National Institution's collections then were transferred to the Smithsonian Institution in 1857–58. In his capacity as Assistant Secretary, Baird also became Director of the National Museum (Rivinus and Youssef 1992). The term "National Museum" was not used until 1859 and it did not appear in the Smithsonian's annual report until 1870, and not in Congressional appropriations bills until four years later (Yochelson 1985).

The original U.S. National Museum was primarily a museum of natural history and ethnography. As the museum and the Smithsonian grew and developed, the National Museum became more of a "holding company" for a variety of semi-independent museums, and the Smithsonian Institution developed and expanded additional interests that were not museum oriented. The U.S. National Museum as an administrative unit was disbanded in 1969, and the various museums became independent bureaus within the Smithsonian Institution, among them the present National Museum of Natural History. For historical and practical purposes, the Natural History Museum prefers the continued use of the initials USNM when referring to its specimens rather than NMNH, because there are throughout the world a number of national museums of natural history. In this paper I use the terms National Museum and Natural History Museum interchangeably.

At the end of 1991, the worldwide avian research collections of the museum, including those of the Fish and Wildlife Service (see beyond), amounted to some 600,000 skins, skeletons, fluid-preserved specimens, eggs, and nests. Many cataloged "duplicates" were given away or exchanged to other museums in the 1800s. Specimen data are being entered into a computer system, but the task is less than 50% complete.

EARLY GROWTH

In the mid– to late–1800s various agencies of the U.S. government—especially the War Department and the Geological Survey—sponsored major exploring expeditions into the western part of the continent. Baird was influential in the selection of Army surgeons who were naturalists (Hume 1942) to take part in these expeditions and collect natural history items, including birds, to be deposited in the National Museum. These collections, and those made by other persons that Baird placed in the field, provided a great opportunity for Baird and others to develop an early understanding of the variation and distribution of birds in the United States.

One of these collectors was John Xántus, an immigrant from Hungary to the United States, who came under the tutelage of Dr. W. A. Hammond while serving in the army as a hospital steward at Fort Riley, Kansas. Hammond taught Xántus how to prepare specimens and put him into correspondence with Baird. In 1857 Baird arranged to have Xántus transferred to Fort Tejon, California, where the collecting was better, although it turned out that opportunities were worse because of personal conflicts between Xántus and the commander of the fort. When Xántus left the army, Baird arranged to have him appointed a tidal observer for the U.S. Coastal Survey, stationed at Cape San Lucas, Baja California (Hume 1942, Zwinger 1968). The specimens that Xántus sent from there, and later from Manzanillo, Mexico, where he served as Consul, were a major addition from areas new to the Smithsonian's interests.

In 1859 Robert Kennicott, an enthusiastic young disciple of Baird, went to the northern fur countries on an expedition that resulted in large shipments of specimens. Kennicott served as a liaison to officials of the Hudson Bay Co., who began to send additional material, and the Smithsonian Institution's collection of American Arctic birds was soon unsurpassed. As the years passed, additional collections were received from later surveys in the west, and important additions came from Alaska, due to the industry of W. H. Dall, H. W. Elliott, E. W. Nelson, Lucien Turner, and others (Gabrielson and Lincoln 1959:6–14).

In 1867 Baird secured the appointment of Robert Ridgway, a young ornithologist from Illinois, as naturalist of the Survey of the 40th Parallel under Clarence King. After two seasons in the field, Ridgway came to Washington to work up his collections. Ridgway was also employed to assist in the preparation of a major work on "A History of North American Birds." The first volume, covering land birds, appeared in 1874 under the joint authorship of Baird, William Brewer, and Ridgway (1874). Ridgway was appointed Ornithologist in the Smithsonian in 1874, and Curator of Birds in 1881, continuing the museum's work on birds as Baird relinquished it for other work, becoming Secretary of the Smithsonian in 1878. Ridgway (Fig. 1) was apparently the first of the Museum's curators. Most of the people who were studying and writing about birds in the 1880s were naturalists in the broad sense, not specialists. Most were able to study birds because they could support themselves in some other way, as doctors or businessmen, administrators or teachers, or from family wealth. Ridgway was certainly one of the earliest to be paid specifically to study birds, one of the first true professional ornithologists (see Farrand 1992).

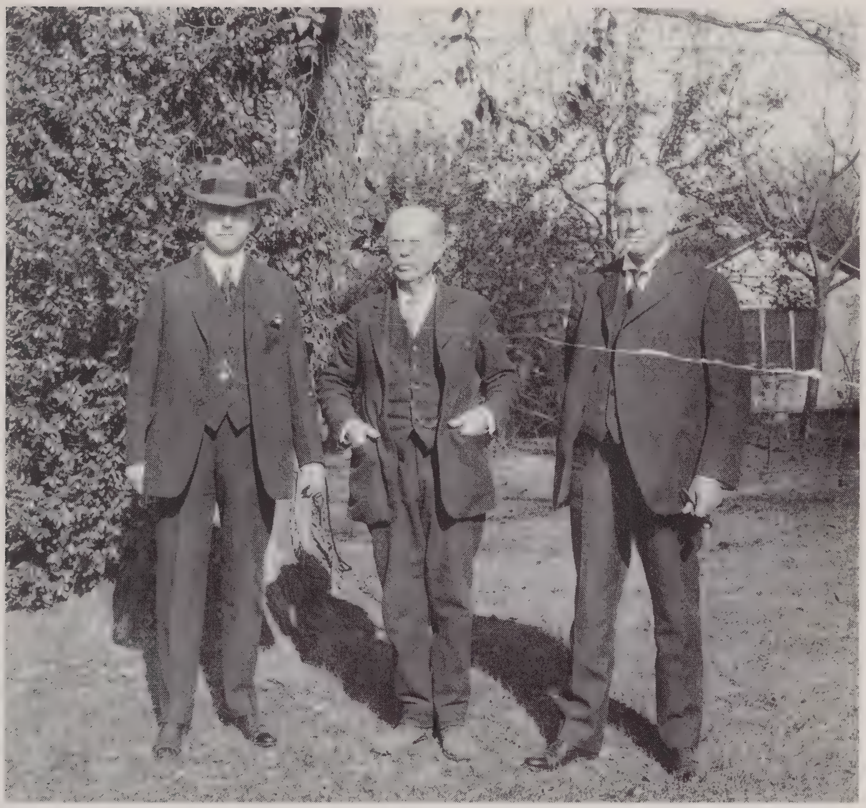

Fig. 1. Bradshaw H. Swales, Robert Ridgway, and Charles W. Richmond (left to right), at Ridgway's home in Olney, Illinois. Photo courtesy of Smithsonian Institution Archives.

THE AMERICAN ORNITHOLOGISTS' UNION AND THE BIOLOGICAL SURVEY

In August 1883, a call went out to 48 leading ornithologists for a meeting in New York to discuss the founding of an American Ornithologists' Union (AOU). Twenty-one persons were able to attend that meeting in September; J. A. Allen of the American Museum and Secretary Baird were detained by sickness and business, respectively. In three days the AOU was founded and organized, the 21 members present electing themselves, plus Allen and Baird, Founders (Palmer 1933). Of the 23 Founders of that organization, nine had, or would soon have, ties with the National Museum—Elliott Coues and Robert Ridgway (both AOU Vice-

Presidents), C. Hart Merriam (Secretary), Spencer Baird, Charles E. Bendire, A. K. Fisher, H. W. Henshaw, E. A. Mearns, and Robert Shufeldt.

Two important committees formed at that first AOU meeting would be instrumental in shaping the future of ornithology in the United States and in the National Museum. One of these was the Committee on Bird Migration, chaired by C. Hart Merriam (Fig. 2). That committee enlisted the aid of ornithologists and others interested in birds from across the country, who sent in their observations on bird migration. The amount of information was almost immediately overwhelming, to the point that the committee could not handle it. The committee turned to the government for help, and in 1885 Congress appropriated funds for the establishment of a Section of Economic Ornithology in the Section of Economic Entomology of the Department of Agriculture. Largely through Baird's influence, the position of Ornithologist was given to Merriam, and Albert K. Fisher was made his assistant. Within the next few years that unit had become the Section of Economic Ornithology and Mammalogy (1889), independent from Entomology, and then the Division (1898) and later Bureau (1905) of Biological Survey. The broad early interests of the Biological Survey would diversify even more widely, and the Bureau would become, in 1940, the nucleus of the U.S. Fish and Wildlife Service (FWS), which was transferred to the Department of the Interior in 1941. Although much of the FWS was housed elsewhere in Washington, there was always a corps of museum-oriented ornithologists and mammalogists at the National Museum, under a variety of administrative organizations (Fisher 1982). In 1993 the research elements of the FWS, including the unit at the museum, were transferred to the newly formed National Biological Survey.

In the beginning, the Survey was housed near the Smithsonian building on the mall in Washington. In 1890, as the Biological Survey began its collecting activities, an agreement was signed that its specimens would be housed in the National Museum. At some point, a major portion of the Biological Survey staff was housed in the Museum to care for and do research on those collections of birds and mammals. Although cataloged with USNM numbers and considered part of the National Collection, Biological Survey specimens were housed separately from Smithsonian specimens within the museum (Yochelson 1985:50). It was not until the 1940s that the two bird collections were physically merged, an action initiated by John W. Aldrich. The general policy that the Biological Survey would curate the North American holdings, and the Smithsonian personnel those from the rest of the world, is still observed.

The other AOU committee whose work is intertwined with the National Museum through the years is the Committee on Classification and Nomenclature, commonly known now as the Check-list Committee. By the 1880s, several ornithologists had developed numbered lists of North

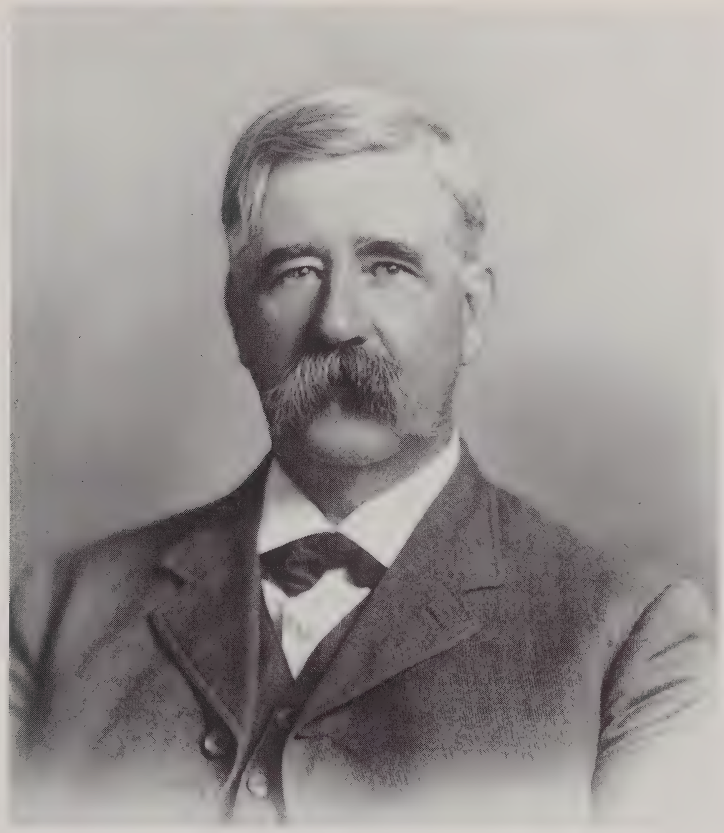

Fig. 2. Clinton Hart Merriam, founder and first Chief of the Bureau of Biological Survey. Undated photo courtesy of Smithsonian Institution Archives.

American birds, in effect their own check-lists. Baird had one, Ridgway had one, and Coues had two. The first Check-list Committee, consisting of Allen, Brewster, Coues, Henshaw, and Ridgway, combined these four lists into a single list, ironing out differences in arrangement and nomenclature. To do this, the committee first developed a Code of Nomenclature (American Ornithologists' Union 1886) to govern their actions. Later committees adopted the International Code of Zoological Nomenclature when it was developed, but this first AOU code was of great significance in the development of standards for taxonomy throughout the world. There has been USNM/Biological Survey representation on the Check-list Committee for every edition, a claim that can be made by no other museum.

Leonhard Stejneger (Fig. 3) was one of the great naturalists early associated with the National Museum through Baird's efforts (Barbour 1944). Although Stejneger is perhaps best known as a herpetologist, his biological career began with important ornithological work. At Baird's instigation, Stejneger investigated the avifauna of the Commander Islands and Kamchatka in 1882–83, and published the results in U.S. National Museum (USNM) Bulletin no. 29 (Stejneger 1885). Some of the earlier Bulletins, a series begun in 1875, dealt with birds, but this is the first of a series of major faunistic Bulletins that resulted from the study of collections amassed by, and for, the National Museum. This was also the first important Smithsonian work outside North America, and Stejneger was the first to state specifically that he was following the AOU's Code of Nomenclature.

COLLECTING AND REPORTING

By the late 1800s the major western expeditions of exploration had ceased. Some of the next field work that brought large numbers of specimens into the National Museum was carried out by the Bureau of Biological Survey. Edward W. Nelson, at age 36 a veteran of several years as a biologist in Alaska and a member of the Death Valley Expedition of 1891, and Edward A. Goldman, age 18, began biological collecting in Mexico in January 1892. Their work there continued, with minor interruption, until 1906. They collected over 12,000 specimens of birds, as well as over 17,000 mammals, not to mention reptiles, amphibians, and plants, which went into the Biological Survey collections in the National Museum. This vast amount of material was never worked up as a unit, but it formed the basis for descriptions of hundreds of new species and subspecies described by the collectors themselves and by their colleagues on the Survey and museum staffs. The birds were especially useful to Robert Ridgway (1901:xii) of the museum in the preparation of his monumental *Birds of North and Middle America.* Goldman's (1951) summary of the field work by Nelson and himself on behalf of the Biological Survey was published by the Smithsonian.

Charles W. Richmond (Fig. 1) was employed as an Assistant Curator of Birds in 1895, and J. H. Riley became an Aide in the collection a few years later. Despite their contributions, these two remain among the less well-known ornithologists of the National Museum, perhaps because they worked in the shadow of men like Ridgway, Coues, Wetmore, and, on the Biological Survey side, Merriam, H. C. Oberholser, and T. S. Palmer. Riley (Fig. 4) worked on a variety of collections acquired by the museum, many from Asia. Richmond followed the bibliophile tendencies of Coues and

Fig. 3. Leonhard Stejneger, ornithologist and herpetologist. Photo courtesy of Smithsonian Institution Archives.

maintained the bird library and associated resources, creating a file to document dates of publication. He also created card files of generic and specific names of birds, recording author, date and place of publication, type species or type locality, and similar data. These card files, some 80 drawers, have been maintained since Richmond's death and were published in microfiche (Richmond 1992). Richmond and B. H. Swales (Fig. 1) worked on a catalog of type specimens in the bird collection, which apparently

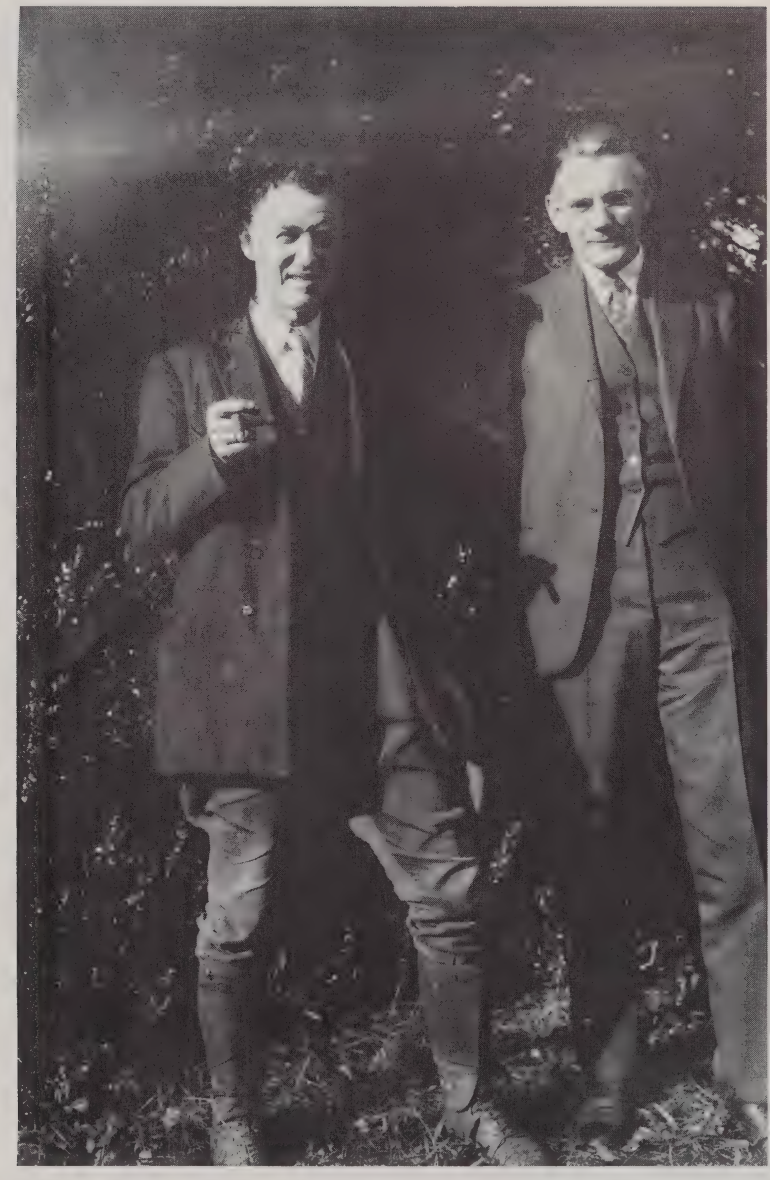

Fig. 4. James H. Riley (left) and Alexander Wetmore at Falls Church, Virginia, 21 October 1928. Photo courtesy of Smithsonian Institution Archives.

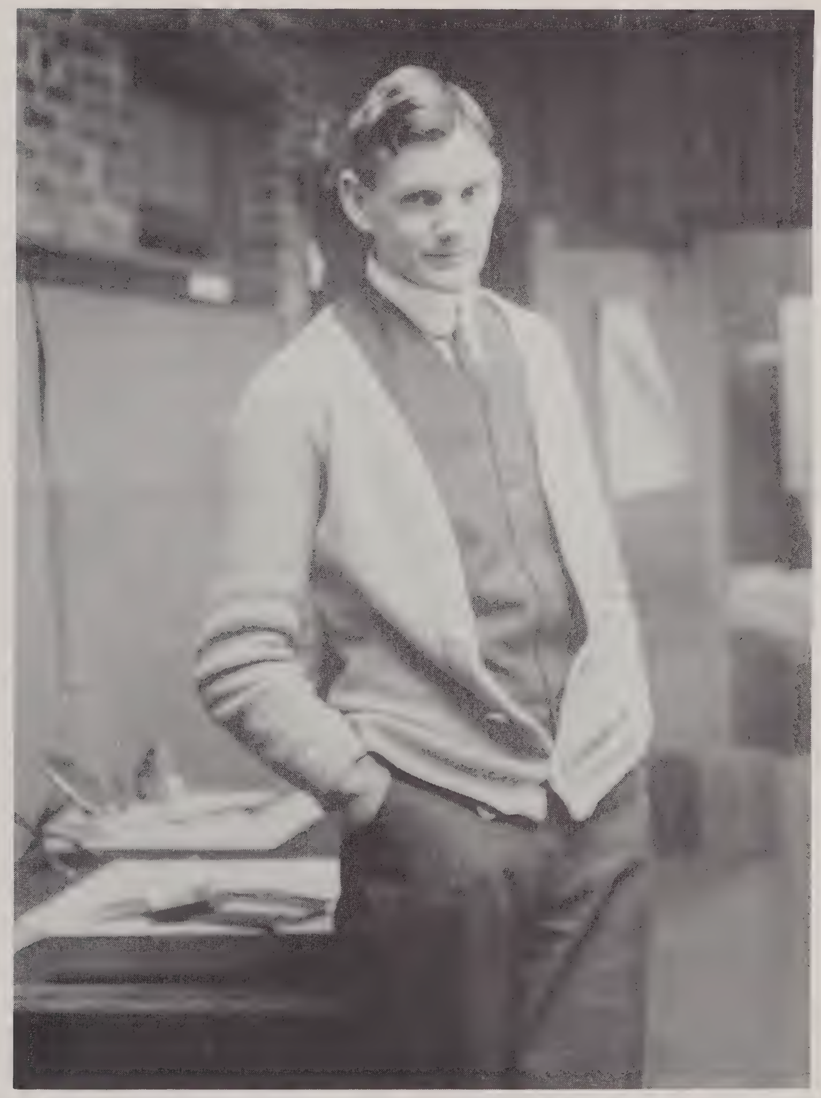

Fig. 5. Alexander Wetmore, an employee of the Biological Survey, ca. January 1914. Wetmore later became Secretary of the Smithsonian Institution. Photo courtesy of Smithsonian Institution Archives.

was never completed; their effort was not mentioned when Deignan (1961) published a list of types.

The Biological Survey, charged with producing knowledge about the fauna of the United States, was concerned about the decrease in some avian populations and about protection for birds, which were recognized as a valuable natural resource. The Survey drafted, and was instrumental in obtaining the passage of, the earliest legislation to protect birds, the Lacey Act of 1901. In 1916 personnel of the Survey negotiated the Convention for the Protection of Migratory Birds, with Great Britain (on behalf of Canada). In 1920, the Survey sent Alexander Wetmore (Fig. 5), first employed in 1910, to South America to study the status of North American migrants, particularly shorebirds, on their wintering grounds. Wetmore was in southern South America for most of a year, spending some of the time in the field with James L. Peters of the Museum of Comparative Zoology, Harvard University. Shortly after Wetmore returned home he was offered a position with the Smithsonian, and soon was Assistant Secretary as well as Director of the National Museum. A report on the collections made during his Biological Survey work in South America was published as a USNM Bulletin (Wetmore 1926).

E. A. Mearns was one of the early ornithologists associated with the museum. Mearns was a U.S. Army surgeon, a naturalist from boyhood in New York, whose first army post was Camp Verde, Arizona (Hume 1942). In 1892 he was assigned as Surgeon and Naturalist for the Mexican-United States International Boundary Commission, and for two years explored—and collected along—the U.S.-Mexican boundary from El Paso to the Pacific Ocean. His specimens were deposited in the National Museum, and Mearns was later assigned to Fort Myer, in Arlington, Virginia, whence he could study the collections in Washington. Unfortunately, the part of his report on birds was never completed. Mearns served two tours of duty in the Philippines during the war with Spain, again making large collections for the Smithsonian. In 1908, President Theodore Roosevelt planned an extensive hunting and scientific expedition to Africa, and asked the Smithsonian to participate. The Smithsonian sent Mearns as naturalist for the party, which sailed for Africa in 1909. Mearns was actually accompanying an old friend—he and Roosevelt had been friends since boyhood and Mearns had mentioned Roosevelt in the first paper he published (Mearns 1878). Mearns collected in Africa for about a year with that expedition. Back in Washington he began writing up the results, but before that was completed he returned to Africa with the Childs Frick Expedition, spending another year collecting. Poor health prevented Mearns from completing reports on either of his African trips, which yielded nearly 10,000 skins, before his death in 1916.

The task of completing Mearns' African reports was sometime later allotted to Herbert Friedmann, who was then teaching at Amherst College and who was an Associate at the Museum of Comparative Zoology, Harvard. Friedmann produced a two-volume USNM Bulletin on the birds of Ethiopia and Kenya (1930–37). By the time this work came out, Friedmann had been made Curator of Birds at the National Museum, after Ridgway's retirement. Friedmann later, as mentioned, continued Ridgway's work on the catalog of the birds of North and Middle America. He later became department chairman at the museum and rekindled his earlier interests in parasitic cuckoos and cowbirds. After he left Washington, Friedmann became Director of the Los Angeles County Museum. Friedmann had taught much earlier at Brown University, where one of his students was John Aldrich, who became the leader of the bird section of the Biological Survey in the museum at Harry Oberholser's retirement in 1941.

Friedmann's place as Curator of Birds was taken by Herbert Deignan. Deignan taught in Thailand from 1928 to 1932, and made a small collection of birds. He returned to Thailand in 1935 and collected extensively, with support from the National Museum, for two more years. These collections, with those of earlier and later collectors, from 1859 to 1939, formed the basis for his USNM Bulletin on birds of northern Thailand (1945), and his checklist of the birds of Thailand (1963). Deignan may be remembered best for his comprehensive listing of type specimens in the U.S. National Museum (1961).

Deignan's was not the first nor last museum foray into southeast Asia. As early as 1896, William L. Abbott had been collecting in that part of the world and sending specimens to the National Museum (Stone 1936). His work in southeast Asia continued until at least 1904. In 1923 Hugh M. Smith went to Thailand as an advisor and expert in fisheries to investigate and develop the fishery resources of the country. He collected in other areas of natural history in his spare time until 1934. This material from Abbott and Smith was worked up as a USNM Bulletin by J. H. Riley (1938). Interest in the ornithology of southeastern Asia was rekindled when S. Dillon Ripley became Secretary of the Smithsonian Institution in 1964.

W. L. Abbott was a medical doctor from Philadelphia who, after a career of about a year, never practiced medicine again. From 1888 until 1923 he explored and collected for the Smithsonian, and was one of the most generous benefactors of the Institution, through material donated and in a bequest that still supports field work. A number of important museum publications resulted from the study of specimens collected by Abbott in various parts of the world. One of his early visits was to Hispaniola, and he returned there many times to make systematic collections. His extensive collection of birds was worked up as a USNM Bulletin by Wetmore and Swales (1931).

SPECIAL PROJECTS

Charles E. Bendire was an Army officer, originally in the Medical Corps, who was also an ornithologist (Hume 1942). He collected extensively, concentrating on eggs, during a distinguished military career. In 1883, while Bendire was on leave in Washington, Baird asked him to become Honorary Curator of the Department of Oology of the museum. The egg collection of the museum was in disarray at the time, but Bendire quickly straightened it out and incorporated his own collection of about 8000 specimens. Then he began a project that both he and Baird had had in mind for some time, an oology of North American birds. The scope of that work was expanded, and the first volume of *Life Histories of North American Birds* was produced in 1892. Volume two followed in 1895. Much material for succeeding volumes was accumulated at the time of Bendire's death in 1897. In 1910 Arthur Cleveland Bent undertook to continue Bendire's work with the cooperation of other American ornithologists. Bent's first volume of life histories covered the diving birds and was published in 1919. In the introduction to that volume, Bent (1919:v) stated that "The Biological Survey . . . placed at my disposal its matchless bibliographical index to . . . North American birds," again emphasizing the close relationship between the museum and the Survey. Bent's own extensive egg collection eventually was deposited in the National Museum. His series of "Life Histories . . ." of North American birds, published as a series of USNM Bulletins and reprinted in recent years by Dover Publications, Inc., New York, is one of the most widely read and cited sets of bird books ever produced.

Robert W. Shufeldt was another Army doctor who, while stationed in Washington as Curator of the Army Medical Museum in 1882, was an Honorary Curator at the Smithsonian (Hume 1942). Shufeldt's specialty was anatomy, principally osteology, but also myology. He was also one of the pioneers of North American paleornithology. Large parts of his collections are deposited in the museum. In the same period, Frederick A. Lucas was Curator of Comparative Anatomy at the Smithsonian; the avian material from that department was transferred to what is now the Division of Birds in 1909. These disciplines again played an important role in the Natural History Museum with Alexander Wetmore's interests in paleontology, continued to the present by Storrs Olson, and in anatomy, continued by Richard Zusi.

Alexander Wetmore, originally employed by the Biological Survey, was one of three Secretaries of the Smithsonian Institution who were ornithologists—the others being Baird and S. Dillon Ripley. His classification of birds of the world (Wetmore 1960) has been followed, at least in

North America, for 50 or more years. After he retired in 1952, Wetmore devoted himself to exploration in Panama, and before his death completed three of four volumes on the birds of that country (1965–72). The fourth volume appeared in 1984 (Wetmore et al. 1984). Wetmore perhaps accomplished more after his retirement than most men do in a career.

The collecting in Mexico by Nelson and Goldman mentioned above was only one aspect of the field work of the Biological Survey. Merriam, along with Vernon Bailey and others, carried on extensive work on both birds and mammals in the southwestern United States. It was in this work that Merriam (1890) developed the Life Zone concept that is still widely used today (Sterling 1977). Many others worked elsewhere in the western states and in Canada, a tradition that continued almost to the present. The extent of that work can be envisioned in part by a listing of some of the state and regional bird books by Biological Survey personnel—*Birds of Alaska*, by I. N. Gabrielson and F. C. Lincoln; *Birds of Newfoundland* (with Harold Peters), *Georgia Birds*, and later *Birds of Idaho*, by Thomas D. Burleigh; *Birds of Alabama* and *Florida Bird Life*, by Arthur H. Howell; *Birds of New Mexico*, by Florence Merriam Bailey, sister of C. Hart Merriam and wife of Biological Survey mammalogist Vernon Bailey; *The Bird Life of Louisiana* and later *The Bird Life of Texas*, by Harry C. Oberholser; *Birds of Oregon*, by Gabrielson and S. G. Jewett, and *Birds of Washington State* by Jewett, W. T. Shaw, W. P. Taylor, and John W. Aldrich.

These, of course, are only a few of the contributions made by the Biological Survey staff working in and around the National Museum (Block 1938). It would not be stretching a point, considering the origin and early history of the Biological Survey, to say that most of the present programs of the Fish and Wildlife Service stem from the early association with the Natural History Museum, although some now seem far afield from museum interests. Soon after I arrived in Washington in 1966 I was invited to attend a meeting of the Service's endangered species committee, then preparing a revision of the first "Redbook" list of rare and endangered species. Three of the four members of that group were from the museum—John W. Aldrich and Richard H. Manville, both of the Fish and Wildlife Service in birds and mammals, respectively, and James A. Peters of the museum's Division of Amphibians and Reptiles. The listing aspects of today's endangered species program have to a great extent relied on the expertise at the USNM and other museums.

Another example of the important work of the museum is the development of the bird banding program in the Biological Survey (Lincoln 1933). The first important scientific banding work in America was done by Paul Bartsch (primarily a malacologist) of the U.S. National Museum, on Black-crowned Night-Herons (*Nycticorax nycticorax*) in 1902–03. Alexander Wetmore, working for the Survey in the Bear River marshes in

Utah from 1914 to 1916, banded over 1200 birds, with 182 returns. In 1919 E. W. Nelson, then Chief of the Survey, offered to take over the then highly dispersed organizational work of bird banding, and in 1920 Frederick Lincoln took charge of this new project. In order that the studies of the banders might be better coordinated, both with the Biological Survey and with each other, banding cooperators were organized into regional associations. The first was the New England group, soon called the Northeastern Bird-Banding Association, now the Association of Field Ornithologists.

Philip S. Humphrey became Curator of Birds in 1961, and soon was Chairman of Vertebrate Zoology. In 1963 he instituted the Pacific Ocean Biological Survey Program, with funding from the U.S. Army. Over the next seven years this program resulted in the banding of 2.5 million Pacific seabirds, including 1.5 million Sooty Terns (*Sterna fuscata*), a major increase in specimen representation of Pacific birds, and more than 100 publications including detailed analyses of the faunas and floras of many Pacific islands and atolls. The program also provided field experience for 65–70 young biologists, many of whom are still active ornithologists today.

In 1960, a jet airliner crashed at the airport in Boston, Massachusetts, as a result of flying into a flock of birds, with the loss of many human lives. Some of the feathers from the birds were sent to the Fish and Wildlife Service offices at the National Museum, where John Aldrich and Roxie Laybourne identified them as from European Starlings (*Sturnus vulgaris*). Since that time, Mrs. Laybourne has identified avian remains from thousands of aircraft-bird collisions for the Federal Aviation Administration, the Navy and Air Force, and airline manufacturers and companies. Information she has provided has been used in the development of stronger windshields on planes and in the development of methods to prevent strikes. She has also identified feathers and other bird parts for the Division of Law Enforcement of the Fish and Wildlife Service—and occasionally for the Federal Bureau of Investigation.

A Laboratory of Molecular Systematics was initiated as part of the museum program in 1988. Although multi-disciplinary in nature, much of the early work of the lab has dealt with problems in avian systematics. Michael J. Braun is Director of this lab.

PUBLICATION SERIES

The Smithsonian Institution initiated a publication series, *Smithsonian Contributions to Knowledge*, in 1848. Thirty-five volumes had been published when the series ended in 1916.

An *Annual Report* of the Smithsonian Institution has been published since 1848; after 1964 the title has been *Smithsonian Year*. Some of the earlier annual reports included papers on birds, and most have information on the collections. Annual reports of the United States National Museum were published from 1881 until 1964. Some papers on birds were included, as were many details on the collections and staff.

Three major Smithsonian/Museum publication series which carried papers on birds for many years were terminated in 1968–69 with the demise of the U.S. National Museum as an administrative unit. *Smithsonian Miscellaneous Collections* was begun in 1860. More than 4700 papers, both long and short, in all fields of science were included in this series. The last volume, 153, was published in 1969, but parts 3 and 4 of volume 150, Wetmore's *Birds of the Republic of Panama,* were published in 1972 and 1984, well after the series "ceased." Other important works in this series included several editions of Wetmore's classification of birds of the world.

United States National Museum Bulletins were published from 1875 until 1969. Bulletins were typically monographs, occasionally collected works on the same subject; all areas of the museum work were included. The first Bulletin on birds was volume 2, J. H. Kidder's report on the birds of Kerguelen Island. Ridgway's *The Birds of North and Middle America,* volume 50, which appeared in 11 parts from 1901 to 1950 (later volumes completed by Friedmann) and the 21 separate volumes of Bent's "life histories" which appeared from 1919 to 1968, are probably the best known of the *Bulletins.*

Proceedings of the United States National Museum began with volume 1 in 1878 and concluded with volume 125 in 1968. The "Proceedings" were shorter, journal-length, papers.

Several new publication series were established in 1969 to replace the Proceedings, Bulletins, and Miscellaneous Contributions. "*Smithsonian Contributions in . . .*" are more nearly discipline-oriented series than those that covered all museum or institutional interests. Papers on avian biology have appeared frequently in the "contributions" series in Zoology, and some have appeared in the series on Paleobiology.

The Biological Survey began a series of *USDA* [Department of Agriculture] *Bulletins* in 1888 or 1889; Bulletin no. 2, by W. W. Cooke on bird migration, is dated 1888 whereas no. 1, by W. Barrows on the English (now House) Sparrow (*Passer domesticus*) is dated 1889. This series of bulletins included papers on birds, mammals, and policy matters such as wildlife laws, and continued through 20 numbers ending in 1907. At the same time, series of less technical *Circulars* and informative *Farmer's Bulletins* were published.

The major museum-oriented publication series of the Biological Survey is *North American Fauna,* begun in 1889. The series continues today; no. 76 was issued in 1991. Most of the series has dealt with mammalian topics, but some important bird papers have appeared (Banks

1971). Other Fish and Wildlife Service series, such as *Special Scientific Report—Wildlife*, begun in 1949, and *Technical Reports*, have been little used by the remaining museum-oriented Biological Survey portion of the Service.

A publication series much used by National Museum/Biological Survey scientists is the *Proceedings of the Biological Society of Washington.* The society, founded in 1880 (Aldrich 1980), has no official connection with either agency, but a significant proportion of its membership and most of its officers have been workers in the museum, and the *Proceedings* have always had a strong in-house presence.

ACTIVITY IN SOCIETIES

One way to consider the influence of an institution on its field is by listing honors received and positions of influence held in the discipline by its staff members. The Brewster Memorial Award is the most prestigious award given by the AOU. Three of the first six awards went to persons associated with the museum or Biological Survey—Robert Ridgway, A. C. Bent, and Florence Merriam Bailey. Wetmore and Friedmann are among later recipients. One of the more important officers of a society is the Secretary. For the AOU, the Secretary has often been at the National Museum—first Merriam for six years, later T. S. Palmer for 20, still later Herbert Deignan, and eventually Richard C. Banks and George E. Watson. Similarly, many National Museum ornithologists have served as Presidents of the AOU—Elliott Coues, Robert Ridgway, C. Hart Merriam, E. W. Nelson, A. K. Fisher, Alexander Wetmore, Herbert Friedmann, John W. Aldrich, and Richard C. Banks. Until the present, National Museum ornithologists have not been particularly active in other ornithological societies, but Banks was recently President of the Wilson Ornithological Society. Most of them were active in the Biological Society of Washington, mentioned in the previous section, and several served as President or as Editor of the Proceedings (Aldrich 1980).

It is impossible in a review such as this to pay tribute to all those who have contributed to the collections of the National Museum of Natural History or to the literature that has resulted from the study of those outstanding collections. The U.S. National Museum of Natural History has had, and will continue to have, an influence in ornithology well beyond those who have been employed by it.

ACKNOWLEDGMENTS

Parts of this brief history were adapted from a short unpublished manuscript by Charles W. Richmond, written in approximately 1920, in the files of the Division of Birds. I thank R. L. Zusi for calling my attention to that manuscript and for sharing some notes on museum history that he had made. The compilation of biographies of A.O.U. members (Palmer et al. 1954) was critical in establishing many ties to the museum and dates. I thank the Smithsonian Institution Archives for providing photographs. In addition to Zusi, I thank M. R. Browning, R. B. Clapp, and R. Hole for comments on versions of this paper.

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APPENDIX I

This appendix lists ornithologists of the Smithsonian Institution and the Bureau of Biological Survey who are associated primarily with the National Museum of Natural History, including those presently (to the end of 1993) on the staff. Of the sub-curatorial staff, only those who have published extensively are listed. Other ornithologists have been and are presently employed by both the Smithsonian and the Fish and Wildlife Service, but at locations (e.g., National Zoo and Tropical Research Institute in Panama of the Smithsonian, and Section of Food Habits, refuges or field offices, various Research Centers or Cooperative Research Units, and administrative offices of the FWS) other than the National Museum, the focus of this paper. Ending dates may be either retirement or death, or some time between; many workers did not leave the museum when they retired. Only Alexander Wetmore is listed as employed by both organizations, but several others worked for FWS and then SI, or vice versa. Other ornithologists worked for the Biological Survey or for the Smithsonian for brief periods before taking a position at an institution elsewhere, with which they are primarily associated.

Smithsonian

Spencer F. Baird	1850–1887
Bruce M. Beehler	1981–
Charles E. Bendire	1883–1897
Gorman Bond	1952–1981
Michael J. Braun	1988–
Elliott Coues	1860–1899
Herbert G. Deignan	1938–1962
Herbert Friedmann	1929–1961
Gary R. Graves	1985–
Philip S. Humphrey	1961–1967
Helen James	1975–
Pierre L. Jouy	1881–1894
Frederick A. Lucas	1882–1904
Edgar A. Mearns	1884–1916
Storrs L. Olson	1971–
William Palmer	1874–1921
William L. Ralph	1897–1907
Pamela C. Rasmussen	1992–
Charles W. Richmond	1894–1932
Robert Ridgway	1869–1915
James H. Riley	1896–1943
S. Dillon Ripley	1964–
Robert W. Shufeldt	1882–1891
Paul Slud	1962–1982
Leonhard Stejneger	1881–1943
George E. Watson	1962–1985
Alexander Wetmore	1924–1978
Richard L. Zusi	1963–

Biological Survey

John W. Aldrich	1941–1989
Richard C. Banks	1966–
Walter B. Barrows	1886–1894
M. Ralph Browning	1971–
Thomas D. Burleigh	1958–1961
Roger B. Clapp	1963–
Allan J. Duvall	1936–1946
Albert K. Fisher	1885–1931
Mercedes S. Foster	1980–
Edward A. Goldman	1892–1925
Henry W. Henshaw	1905–1916
Marshall A. Howe	1973–1980
Roxie C. Laybourne	1944–
Joe T. Marshall	1976–
C. Hart Merriam	1885–1910
Edward W. Nelson	1890–1929
Harry C. Oberholser	1895–1941
Theodore S. Palmer	1892–1953
Lester L. Short	1961–1966
W. E. Clyde Todd	1891–1899
John S. Weske	1972–1978
Alexander Wetmore	1910–1924

3

Gentlemanly Specialists in the Age of Professionalization: The First Century of Ornithology at Harvard's Museum of Comparative Zoology

Mark V. Barrow, Jr.[1]

ABSTRACT.—This paper chronicles the first century of ornithology at Harvard's Museum of Comparative Zoology (MCZ). During this period, founder Louis Agassiz's ambitious vision for the institution—which included collection development, advanced scientific education, original research, and public exhibition—has been continually renegotiated in response to changes in personnel, innovations in the biological sciences, and ongoing budgetary constraints. Not long after the MCZ formally opened its doors in 1859, its Bird Department had amassed an impressive collection that became the basis for an extensive series of research publications. However, until recently the curators affiliated with this department have generally lacked formal scientific training, received little or no financial compensation, pursued traditional taxonomic research, and had minimal contact with students. Not until the 1950s did MCZ officials hire the first staff members with Ph.D.s in ornithology, and only then did the institution begin to attract a significant number of graduate students in the field. Although the MCZ has long served as an important center of ornithological activity in North America, in its publication program, hiring practices, and basic orientation, it has continued to resemble a nineteenth-century museum well into the twentieth century.

During the nineteenth century Western science experienced a series of radical transformations in social structure. Professionalization was at the core of what Mendelsohn (1964) has aptly characterized as a "second scientific

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revolution." Although the process of professionalization occurred at varying rates across different specialties, institutions, and nations, the general trend is unmistakable. As the century wore on, gentlemanly amateurs—men of wealth, leisure, and social standing who had long dominated the practice of science—slowly but steadily lost ground to full-time, paid specialists (Daniels 1967, Reingold 1976, Rudwick 1985, Bruce 1987, Kevles 1988). Institutions of higher learning, which greatly expanded training and employment opportunities for individuals desiring to pursue science as a vocation, were a central part of this transformation (Veysey 1965, Bledstein 1976, Geiger 1986).

Providing advanced training and suitable positions for aspiring "professional naturalists" were an important part of Louis Agassiz's agenda as he sketched out the conceptual and architectural blueprints for the MCZ in the mid-nineteenth century (Annual Report 1863:6-7). However, these goals were only one component of a much larger museum mission that also included the promotion of original research, collection development, and public exhibition. Continuing budgetary shortfalls, transformations in the methods and institutional structure of biological research, and changes in personnel soon forced a retreat from this ambitious mission. Although the MCZ provided employment for numerous paid specialists with solid academic credentials, during its first century the curatorial staff often lacked formal scientific training, failed to receive salaries, and remained isolated from the academic life of Harvard University. Rather than promote the professionalization of science, as Agassiz had initially hoped, the MCZ proved to be one of the last bastions of an increasingly outmoded form of social organization.

For much of its first century the MCZ was also wedded to an older form of biological practice. Like most other museums, the MCZ was founded and long remained oriented around the pursuit of traditional natural history: the collection, description, naming, and classification of organisms based largely on external morphology. By the late nineteenth century, this taxonomic approach came to be increasingly challenged by a new, more experimentally based biology focused on embryology, genetics, and cytology (Allen 1978, 1979; Mayr 1980a; Maienschein et al. 1981; Pauly 1984; Maienschein 1991). As the new biology began transforming the epistemological, theoretical, and methodological foundations of research in the life sciences, the traditional natural history museum came to be supplemented (and in some cases replaced) by the modern biological laboratory, complete with living organisms, experimental apparatus, and new manipulative techniques (Benson 1988). Like the movement toward professionalization to which it was closely related, the new biology did not immediately or completely supplant more established forms of organization and practice. But as it became more firmly entrenched in the educational, institutional, and funding structure of American science, the status of taxonomically based natural history declined significantly.

Nowhere is the MCZ's policy of continuing to rely on gentlemanly specialists and its orientation toward traditional natural history more evident than in the Bird Department. Part of the explanation for the Department's insulation from these major developments is undoubtedly related to the field of ornithology itself, which remained open to amateur practitioners and narrowly focused on problems of classification and nomenclature well into the twentieth century (Ainley 1979, Barrow 1992). However, long after other universities established active graduate programs in ornithology and scientists began expanding the boundaries of ornithological research, the MCZ Bird Department continued on the basic course it had set for itself in the nineteenth century. By the early twentieth century, its curatorial staff had amassed a large, diverse, and internationally acclaimed ornithological collection that furnished the basis for a steady stream of taxonomic publications. Yet, the Department continued to be dominated by scientists who lacked formal biological training, received little or no pay for their efforts, and rarely offered undergraduate courses or supervised graduate students. Only in the post-World War II era—when MCZ officials hired the first staff members with Ph.D.s in ornithology and the institution finally became an important training ground in the field—did the situation begin to change significantly.

The Origin and Early Years of the Museum of Comparative Zoology.—The MCZ was the brainchild of the internationally renowned Swiss naturalist Louis Agassiz (Agassiz 1930, 1936; Lurie 1959, 1960; Winsor 1991). Agassiz first came to the United States in 1846 to deliver a series of popular lectures on natural history. As he traveled across the nation, he captivated his audiences with his charm, enthusiasm, and knowledge. Among those who fell under Agassiz's spell were a group of Harvard University officials and patrons in the midst of organizing the Lawrence Scientific School (Love 1944, Lurie 1959, Rossiter 1966, Miller 1970, Zaidenberg 1974, Elliott and Rossiter 1992). In 1847 they offered the 40-year-old naturalist a professorship in natural history and geology.

Soon after accepting the appointment, Agassiz initiated a campaign for a suitable structure to house the specimens he had gathered through an aggressive program of collection, purchase, donation, and exchange. A proper museum building was vital, Agassiz argued, to preserve and arrange the specimens used to demonstrate his lectures. Following a series of persuasive appeals, Harvard officials provided Agassiz with a small abandoned bathhouse on the banks of the Charles River (1848), the upper story of a larger two-story wooden building on Kirkland Street (1850), and the remainder of that same building (1855) to house his burgeoning collection.

As his supporters soon realized, Agassiz had much grander ambitions. By the middle of the nineteenth century, numerous governmental agencies, scientific societies, colleges, and private entrepreneurs across the United States had established natural history museums (Oleson and Brown 1976; Porter 1986, 1990; Kohlstedt 1988a,b; Orosz 1990; Porter 1990). These institutions served a variety of functions, ranging from research and teaching to turning a profit. Yet few survived much beyond the initial burst of enthusiasm that typically surrounded their creation, and even the more enduring examples usually remained modest in scale. By 1850 only two American institutions—the Academy of Natural Sciences of Philadelphia (founded in 1812) and the Boston Society of Natural History (founded in 1830)—had amassed collections of the size and importance to attract international attention (Sclater 1857; Bouvé 1880; Gerstner 1976; Kohlstedt 1976, 1979; Orosz 1990).

Although one of America's premier natural history museums was across the Charles River, by 1854 Agassiz began to call for the establishment of a new museum in Cambridge. What Agassiz sought was a museum that would not only surpass anything currently found in the United States, but even rival the leading institutions of Europe: the British Museum in London and the National Museum of Natural History in Paris. Over the next two decades he convinced wealthy philanthropists, Harvard administrators, state legislators, and ordinary citizens to contribute the hundreds of thousands of dollars required to transform this ambitious dream into a reality. By late 1859 Agassiz and his student-assistants moved his growing collection into a new, four-story brick building laid out according to Agassiz's specifications and constructed on a large lot provided by the Harvard Corporation. Although impressive, the new building—dubbed the Museum of Comparative Zoology—was merely the first installment of what would eventually become a vast museum complex to occupy the site.

Central to the success of Agassiz's venture were his student-assistants. As an integral part of their scientific training at Harvard, Agassiz required his students to work long hours in his museum. After a brief period of service, more advanced students were often given charge of a particular museum department. As curators in all but name, the students were responsible for helping to acquire, process, and write-up the flow of new specimens that arrived in Cambridge almost daily.

During the early years of the MCZ, the relationship between Agassiz and his student-assistants was intimate, mutually beneficial, and unprecedented among institutions of higher learning on either side of the Atlantic. With free access to their mentor's specimens, knowledge, and advice, the students quickly became competent naturalists. Many began presenting papers to scientific societies and making regular contributions to the literature. At the same time, Agassiz depended on his faithful corps of workers to staff his burgeoning museum at a minimal cost. As he frankly acknowledged in 1861, without student-assistants the MCZ would "necessarily come to a stand-still" (Annual Report 1861).

During Agassiz's heyday, between 1854 and 1864, an entire generation of American naturalists—most of whom later went on to distinguished careers—served as his apprentices. But then the innovative educational system began to founder. During the winter of 1863-1864, at the height of the American Civil War, the MCZ experienced its own mini-rebellion (Lurie 1960:312-318, Zaidenberg 1974, Dexter 1979, Winsor 1991:43-65). By the time the dust settled several months later, a number of disenchanted students had abandoned the institution. The episode also embittered Agassiz, who recruited relatively few advanced students to work at the MCZ from that point on. In their place, he began to rely on a smaller number of more established naturalists to curate his collections. A decade after his bold experiment in advanced scientific education had been initiated, it had been brought to an abrupt end.

Building the Bird Collection: The J. A. Allen Years (1862-1885).—One of the first acquisitions recorded in the MCZ bird catalog was a series of 25 specimens purchased by Louis Agassiz at one of his most lucrative collecting grounds—the Boston Market—in the winter of 1846-1847. The birds are testimony to Agassiz's desire to obtain representatives from a wide variety of taxa for his collections. Although committed to a policy of diversification, Agassiz tended to concentrate most on organisms that were of particular research interest to him or that were generally under-represented in other North American museums. As a result, significant growth of the bird collection did not really begin until students with a special interest in ornithology began arriving at the MCZ.

The first such student was Addison Emery Verrill, who came to Harvard in 1859 hoping to receive the training necessary to pursue a career in ornithology (Coe 1929). In 1862 Verrill, whom Agassiz had recently appointed to oversee the MCZ bird and mammal collections, contributed the first separate "Report on Birds" to the MCZ's Annual Report. In his account of the previous year's activities, Verrill boasted that the bird collection had grown by an impressive 2274 specimens, representing over 453 species. He issued a second brief report on the bird collection the following year, before abandoning the MCZ during the student rebellion. Verrill—whose research was increasingly oriented toward marine invertebrates—was luckier than many of his fellow students who left the MCZ that year: he soon found suitable employment at Yale University, where he was to enjoy a long and distinguished career.

The individual most responsible for bringing the MCZ bird collection to the level of national and even international importance was Verrill's successor, Joel Asaph Allen (Allen 1916; Stone 1921; Chapman 1922, 1927; Osborn 1928; Sulloway 1990). Allen began collecting birds as a teenager on his family's farm in Springfield, Massachusetts. Despite his father's continued opposition to his natural history pursuits, the 23-year-old Allen enrolled as one of Agassiz's special students in the winter of 1862. The sale of his prized mounted bird collection provided the funds for his first semester's room and board in Cambridge (Allen 1916:8, Eliot 1935). After his first term of study, Agassiz assigned Allen to work in the Bird Department under Verrill, where he helped catalog the growing collection. A little over a year later, Agassiz placed Allen in charge of the MCZ bird and mammal collections as a reward for his continued educational progress and his loyalty during the recent student rebellion.

Under Allen's able leadership, the bird collection quickly grew in size and importance. Although purchase and donation were the most important sources of new acquisitions, during his first decade at the MCZ, Allen also added to the collection through his own fieldwork (see Allen 1916:43-44, Peters 1936). Most of his collecting was confined to North America, but in 1865 he accompanied Agassiz and a number of other students and associates on an expedition to Brazil sponsored by the Boston banker and philanthropist Nathaniel Thayer. Illness forced Allen to return home early, but he and his co-workers managed to bring back over 1400 specimens.

As a result of Allen's ongoing efforts, the MCZ bird collection expanded greatly over the next two decades. As late as 1867 Agassiz argued that it was a "mistake" for natural history museums to "repeat each other" in their acquisition programs and that in a spirit of cooperation he had decided not "to form a collection of birds which might compete with that of the Academy of Natural Sciences in Philadelphia, or with that of the Boston Society of Natural History" (Annual Report 1867:10). But only three years later, Allen had cataloged over 20,000 specimens, including 6000 preserved in alcohol (Annual Report 1870:15). Although the pace of expansion diminished soon after the death of Louis Agassiz in 1873, by the time Allen left for the American Museum of Natural History in 1885, the bird catalog contained over 33,000 entries. Under Allen's constant prodding, the MCZ bird collection had grown into one of the largest in the United States.

Collection size alone fails to convey Allen's importance in placing the MCZ on the national and international ornithological map. Through a variety of activities—research, institution building, and teaching—Allen soon established himself as a leader of the American natural history community and one of the MCZ's most accomplished curators.

At the base of Allen's growing reputation was his research. He was a prolific author responsible for hundreds of articles and dozens of taxonomic monographs on North American birds and mammals (Allen 1916). Most of his publications were descriptions of new species and subspecies

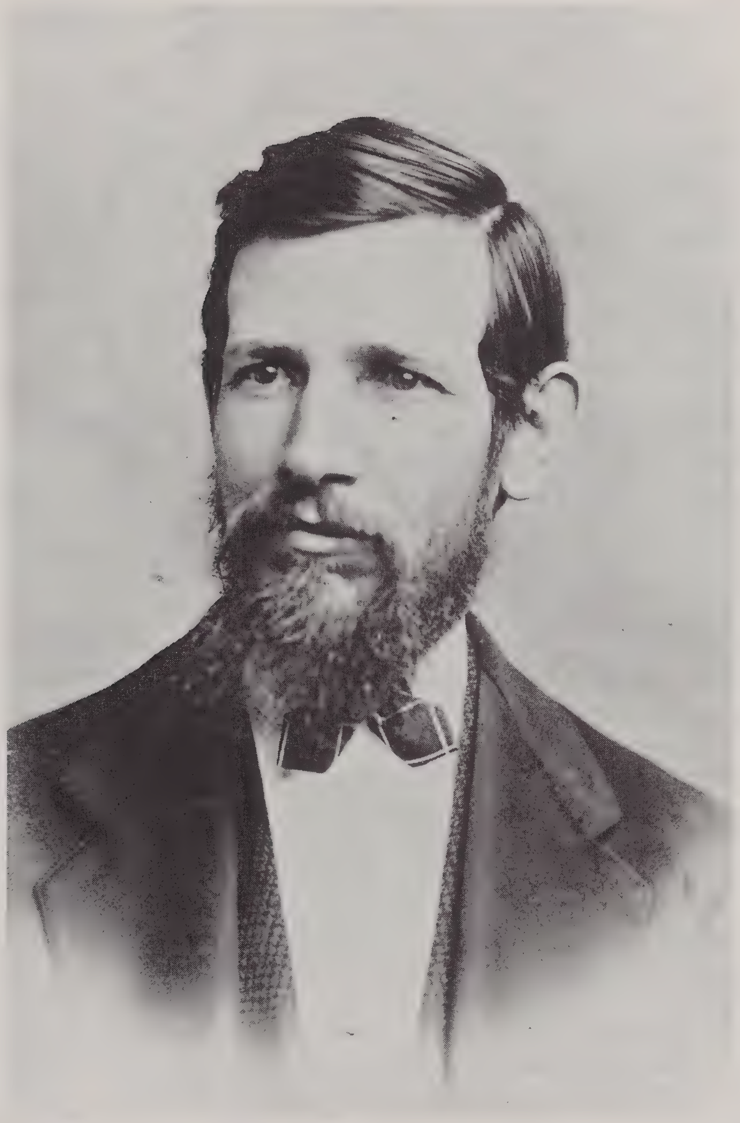

Fig. 1. J. A. Allen, Curator of the MCZ Bird Department, ca. mid-1860s to 1885. This portrait was made around 1876. Allen trained under Louis Agassiz during the mid-nineteenth century, when the MCZ was as an important center for advanced education in science. One of the institution's most accomplished curators, he greatly expanded the size of the MCZ bird collection, helped to found the American Ornithologists' Union, and made numerous contributions to biogeographical and evolutionary theory. Photograph courtesy of Museum of Comparative Zoology, Harvard University.

or taxonomic and nomenclatural revisions—the kind of important but rudimentary groundwork that would characterize the research of Allen's successors in the Bird Department for the next seven decades. But he also offered a number of more fundamental, theoretical contributions to biogeographical and evolutionary theory. For example, one of his most important publications during this period was a monograph on the mammals and birds of Florida (1871), a study that became instrumental in the development of the American version of the subspecies concept (Sharpe 1873, Stejneger 1884, Stresemann 1975:244-245, Barrow 1992:300-317). Later Allen (1877) argued that the environment directly induced the morphological differences that correlated with climatic differences across the geographic range of a given species, a strain of neo-Lamarckism prevalent in American ornithology until the evolutionary synthesis of the 1930s and 1940s (Mayr 1980b:417-418, Bowler 1983:118-140). Although Allen's neo-Lamarckian explanation for geographical variation eventually fell into disfavor, his seminal contribution to the field of biogeography has been memorialized in Allen's Rule, which states that appendages of closely related, warm-blooded vertebrates tend to be longer in warmer climates and shorter in cooler climates.

Allen was also central to the institutional development of North American ornithology. In 1876 he was recruited to edit the newly launched *Bulletin of the Nuttall Ornithological Club*, his first in a series of key editorial positions (see the list in Allen 1916:44). His decision to accept the appointment marked the beginning of the close relationship between the MCZ and the Nuttall Ornithological Club that has continued to this day (Batchelder 1937, Davis 1987). In 1883 Allen joined Nuttall Club President William Brewster and Honorary Member Elliott Coues to issue a formal call for the creation of the American Ornithologists' Union (AOU) (Palmer 1933, Cutright and Brodhead 1981:261-276, Barrow 1992:200-213). Allen was elected president of the new organization and editor of its official publication, *The Auk*, created when the Nuttall Club agreed to suspend publication of its *Bulletin* and relinquish its subscription list to the AOU.

In 1871 Allen initiated at Harvard the first specialized course in scientific ornithology ever offered in an American university (Anon. 1871:104, Allen 1916:44). Although he had planned to deliver a series of 12 lectures on the morphology and classification of birds, he became discouraged when only a handful of students attended the initial sessions. His disappointment at the low turnout led him to abandon the venture before completion. Allen, who was extremely shy, never found the courage to venture into the classroom again.

Although Allen had accomplished a great deal during his more than two-decade tenure at the MCZ, he was forced to leave in 1885 as a result of changing policies and continued financial difficulties at the institution.

The principle of multiple use—teaching, research, and public exhibition—had been central to Louis Agassiz's vision for the MCZ since its founding. On the surface, Alexander Agassiz, who became Director of the Museum after his father's death in 1873, remained firmly committed to this ambitious vision. Using a generous portion of the fortune he made investing in and managing copper mines in Michigan, Alexander Agassiz completed the extensive MCZ building complex that had first been laid out by his father (Agassiz 1913, 1930; Winsor 1991:135-146). He also bolstered the Museum's public exhibits, which had received only minimal attention up to that point. The younger Agassiz's improvements won high praise from Alfred Russel Wallace (1887), the British co-discoverer of the theory of evolution by natural selection, who pronounced the facilities superior to those at the British Museum and other important European institutions.

But behind the doors of the MCZ, away from public view, Alexander Agassiz instituted or passively accepted a number of changes that threatened to fundamentally transform the institution. Under Alexander Agassiz's leadership, the gap between teaching and curation at the MCZ markedly increased. Although the elder Agassiz had all but stopped taking new advanced students after the rebellion of 1863-1864, he remained firmly committed to providing undergraduate education. Following his death in 1873, the new reform-minded President of Harvard, Charles W. Eliot, moved to make zoological instruction independent of MCZ staff (Hawkins 1972, Winsor 1991). The younger Agassiz, who found teaching personally distasteful, apparently did nothing to challenge this move and may have even encouraged it. While the MCZ continued to remain the site of Harvard zoological instruction until the completion of a separate Biological Laboratories building in 1932, with a few rare exceptions, MCZ staff no longer provided that instruction (Annual Report 1898:7, Annual Report 1947:3, Romer 1948:13, Winsor 1991:182)

At the same time, Alexander Agassiz began to openly question whether the great expense entailed in gathering and maintaining the vast MCZ collections was worth the relatively little original research that had thus far been based upon them. As early as 1876 he asserted that modern zoological research required field stations to supplement museums, a claim with which his father would have undoubtedly been sympathetic (Annual Report 1876:5-6). By 1884 he had expanded this general line of reasoning by arguing that the MCZ's policy of continued large-scale specimen accumulation and maintenance was "far too costly" and that "the same sum spent in a different direction, in promoting original investigations in the field and the laboratory, and in providing the means for publication of such original research, would do far more towards the promotion of natural history than our past methods of expending our resources" (Annual Report 1884:5-6). The younger Agassiz's statement reflected the changing realities of biological research at the end of the nineteenth century—research that was increasingly oriented toward experimentation and the study of living organisms (Allen 1978, 1979; Mayr 1980a; Maienschein 1991)—as well as his continued frustration at having to meet the annual shortfall between the MCZ's expenses and its insufficient endowment income. By 1891 Agassiz declared that he was no longer willing to provide the constant infusion of funds the Museum required. The initial plan to make the MCZ a major center of original research, Agassiz argued, could not be carried out without an increase in the endowment or more financial support from the university (Annual Report 1891:8-9). Despite repeated pleas, neither was immediately forthcoming.

Alexander Agassiz's lingering doubts about the value of continuing to amass specimens—many of which had never even been unpacked—translated into a policy of retrenchment in the research collection during much of his tenure. In 1874, the year in which he took over his father's position, 20 people (including a number of volunteers) were caring for the MCZ collections. Six years later the number of curators had been effectively reduced to four (Winsor 1991:214). This staff reduction was paralleled by a proportional decrease in the level of new acquisitions for the MCZ research collections (see Annual Report 1878:7). It is no wonder that when a suitable position at the American Museum of Natural History came open in 1885, Allen jumped at the opportunity to leave.

Retrenchment: The William Brewster Years (1885-ca. 1900).—Allen's replacement, William Brewster, was an ideal choice to reflect Alexander Agassiz's concern about reducing expenses and countering what he believed to be an overemphasis on specimen acquisition at the MCZ. Brewster lacked formal scientific training, but he was a highly respected ornithologist and proud owner of one of the largest private bird collections ever gathered in this country. Although he watched carefully to make sure the MCZ bird collection did not fall victim to insect infestation, during his early years of service Brewster remained more intent on continuing to build his own collection than that of the MCZ. And perhaps most importantly, his position was strictly honorary; unlike his predecessor, the independently wealthy Brewster drew no salary from the coffers of the financially distressed institution.

The son of a prominent Boston banker, Brewster began collecting birds and eggs in the vicinity of his Cambridge home at the age of ten (Chapman 1919, Henshaw 1920, Stone 1929, Brooks 1980a:47-51). After abandoning plans to study at Harvard due to repeated bouts with ill health, he served a brief stint in his father's banking firm. The experience convinced the 19-year-old young man that he was unsuited for a career in business. With his family's blessings, Brewster decided to devote himself

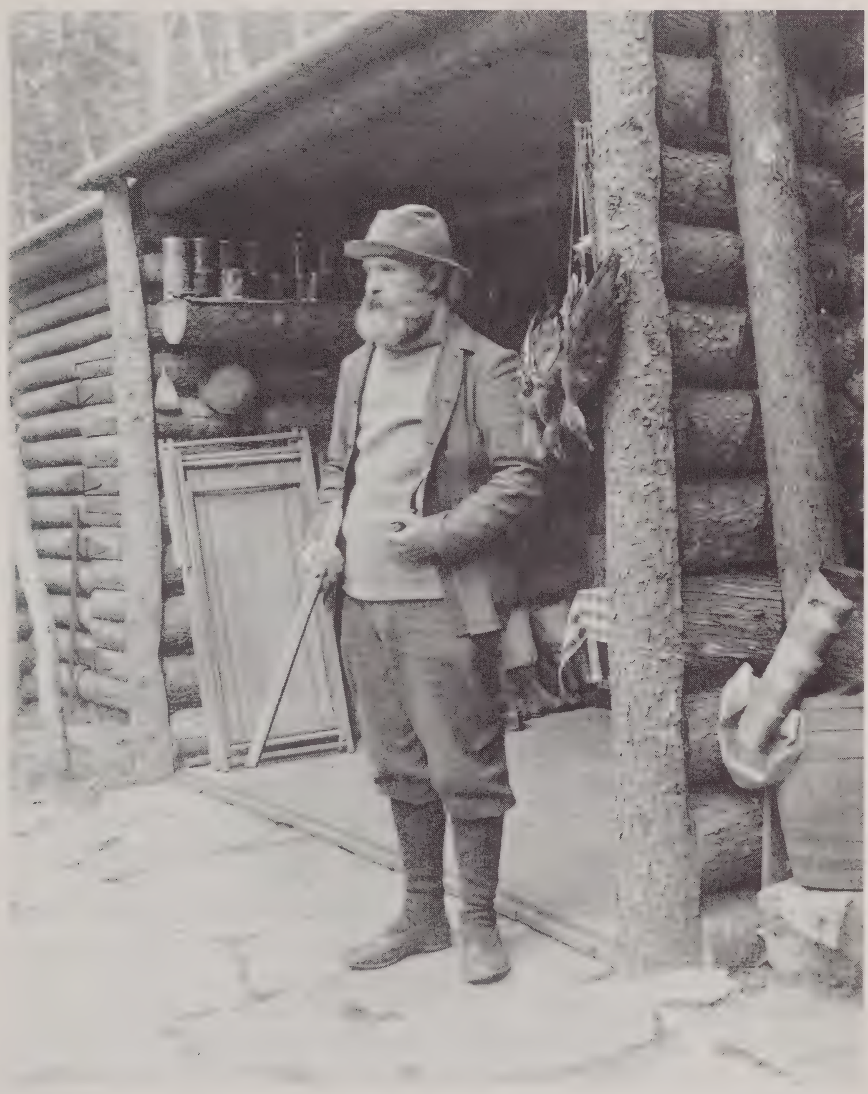

Fig. 2. William Brewster, Curator of the MCZ Bird Department, 1885-1919. This photograph was taken in September 1895, at Pine Point Camp, Lake Umbagog, Maine. Brewster—who lacked formal scientific training and served in an honorary capacity—is typical of the gentlemanly specialists who cared for the MCZ bird collection from the 1880s to the 1950s. Outram Bangs assumed most of his curatorial duties around 1900, though Brewster remained officially in charge of the bird collection until his death in 1919. He left the Bird Department a generous endowment and his extensive skin and mount collection, one of the largest private bird collections ever amassed in this country. Photograph courtesy of Museum of Comparative Zoology, Harvard University.

entirely to his first love: the study of birds. In 1873 he and several like-minded collectors in the Cambridge area joined together to establish the Nuttall Ornithological Club, the first ornithological society in the United States. Brewster presided over the organization until his death nearly five decades later (Batchelder 1937, Davis 1987). Ten years after initiating the Nuttall Ornithological Club, Brewster became one of the three founding members of the AOU. Unlike most scientific ornithologists during this period—whose research centered almost exclusively on taxonomic studies based on museum specimens—Brewster was also interested in describing the living bird in its environment (Batchelder 1951a, Brooks 1980a,b).

When first approached about filling the position left vacant by Allen's departure, Brewster made it clear he had little time to spare for the MCZ collection of birds and mammals (Annual Report 1919:8-9). Consistent with Alexander Agassiz's emphasis on improving MCZ exhibits, the only significant acquisitions during the first 14 years of Brewster's curatorship were two extensive collections of mounted specimens: 1200 North American birds and about 300 North and South American hummingbirds donated in 1892 by the widow of Greene Smith, and a collection of 3000 North American and West Indian birds donated in 1895 by former Agassiz student W. E. D. Scott (Anon. 1880, 1881; Annual Report 1892:29-31, 1895:9; Scott 1904). However, large acquisitions like these were exceptions rather than the rule during the first decade and a half of Brewster's curatorship. The brief report on the bird collection for 1897 is more typical: "The past year has been singularly uneventful as far as the present department is concerned" (Annual Report 1897:31-32). Although Brewster remained nominally in charge of the MCZ bird collection until his death in 1919, for the reasons discussed below, Outram Bangs took over his curatorial duties beginning around 1900.

Paralleling the decline in the level of acquisitions under Alexander Agassiz was a change in how zoology was being taught at Harvard. In a curious institutional speciation event, the MCZ's field- and museum-based program of teaching, research, and collection development became split into two increasingly independent entities. Backed by an endowment and operating funds supplied largely by Alexander Agassiz, the MCZ maintained its general orientation toward taxonomic research (and to a limited extent, collection development), but gradually relinquished its undergraduate and graduate teaching role. At the same time, strong financial support from Harvard College and pressure from younger faculty members fresh from European Ph.D. programs, pushed Harvard's zoological curriculum toward the new laboratory-based biology.

A central figure in this transformation was Edward Laurens Mark, whom Harvard President Eliot appointed as instructor in zoology in 1877. Mark came to his new position with a Ph.D. from the University of Leipzig and a strong desire to bring the zoological curriculum at Harvard more into line with contemporary European trends. As he became the senior member of the Zoological Department over the next two decades, he introduced more laboratory work and increasing use of German cytological techniques to the Harvard zoological curriculum (Mark 1930:382-391, Romer 1948:14-15). Thus a rift was opened up between MCZ curators, who remained largely wedded to nineteenth-century research methods well into the twentieth century, and the new teaching staff that fully embraced the questions, methodologies, and opportunities of the new biology.

One of those particularly distressed by this transformation was Theodore Roosevelt. Roosevelt, who began collecting birds as a young boy, received his own double-barrelled shotgun and lessons in taxidermy by the age of 14 (Roosevelt 1926, Cutright 1985). Four years later he entered Harvard College with the dream of becoming a professional naturalist in the mold of his boyhood heroes: John James Audubon, Louis Agassiz, and Spencer Fullerton Baird. Much to his chagrin, when he was finally eligible to enroll in natural history courses during his sophomore year, he discovered that the Harvard zoological curriculum "utterly ignored the possibilities of the faunal naturalist, the outdoor naturalist and observer of nature." Instead of emphasizing field work as he had hoped, his instructors "treated biology purely as a science of the laboratory and the microscope, a science whose adherents were to spend their time in the study of minute forms of marine life, or else in section-cutting and the study of the tissues of the higher organisms under the microscope" (quoted in Cutright 1985:127). Roosevelt later claimed that his disappointment extinguished his desire to become a professional naturalist.

In 1893, 13 years after Roosevelt graduated *magna cum laude*, the Harvard Board of Overseers appointed him to a three-man visiting committee charged with reviewing the Zoological Department. Roosevelt, then an up-and-coming Federal Civil Service Commissioner, revisited his alma mater and interviewed a number of zoology faculty and MCZ curators, including William Brewster. Given his background, it is hardly surprising that Roosevelt's report called for the reintroduction of field work to supplement what he believed to be an overemphasis on laboratory studies at Harvard (Roosevelt 1902). The other two members of the committee filed a dissenting report, which largely defended the status quo, but did call for a new course in systematics to round out the increasingly laboratory-oriented undergraduate curriculum. In her account of the episode, Winsor (1991:194-195) has emphasized the irony of a zoology program at Harvard being taught inside the walls of Agassiz's world-renowned museum, but almost entirely divorced from that institution's collections, curators, and intellectual traditions.

Renaissance: The Outram Bangs Years (ca. 1900-1932).—As the nineteenth century drew to a close, several events signaled the beginning of a remarkable reawakening within the MCZ's Bird and Mammal Departments. In 1898 Alexander Agassiz decided to withdraw from the continued frustrations associated with the day-to-day administration of the Museum (although he continued to remain in control of the institution until his death in 1910). One year later the two departments received their largest acquisitions to date when Henry Bryant Bigelow deposited the Bigelow-Bryant collection of 8000 North American and West Indian bird skins, and the MCZ Visiting Committee raised a $5000 subscription to purchase the extensive mammal collection of Edward A. and Outram Bangs (Annual Report 1901:29-30, 1905:27-29). Numbering over 10,000 mammal skins and skulls and 100 types, the Bangs collection filled a major gap in the MCZ research collections. Although Outram Bangs was now actively engaged in collecting and researching birds, MCZ officials appointed him Honorary Assistant in Mammalogy. He also effectively took charge of the bird collection (even though William Brewster remained the official MCZ Curator of Birds until his death in 1919) and led it through its most active period of growth. That same year Bangs joined four other naturalists (formally or informally affiliated with the MCZ) to create the New England Zoological Club. The sole purpose of the new organization was to issue an irregular *Proceedings*, an outlet for the rapid publication of taxonomic papers designed to help insure priority for its members and their associates (Barbour 1929, Batchelder 1947).

Like his predecessors at the MCZ, Bangs had developed a fascination for natural history at a young age (Barbour 1932, G. M. Allen 1933, Peters 1933). He and his older brother, Edward, were inseparable companions as they scoured the countryside surrounding their Watertown, Massachusetts, home searching for additions to their prized bird and egg collection. The Bangs brothers soon met up with Charles J. Maynard, a local natural history dealer who sold them specimens and taught them how to make proper skins (Townsend 1930, Stone 1933, Batchelder 1951b). After graduating from Harvard College in 1884, Outram Bangs spent a brief period in the office of the Chicago, Burlington & Quincy Railroad, before retiring from business. He and his brother continued to build up their bird collection until 1890, when they shifted to mammals. After several years of intensive field work, between 1894 and 1899 Outram Bangs published over 55 articles on mammals. Like his later publications, these generally consisted of descriptions of newly discovered species and subspecies (Porter 1943). Devoid of formal education in natural history or biology, Bangs was a prolific, though uninspired author who avoided making the kind of generalizations that might have made a more lasting mark on the literature of ornithology and evolutionary biology.

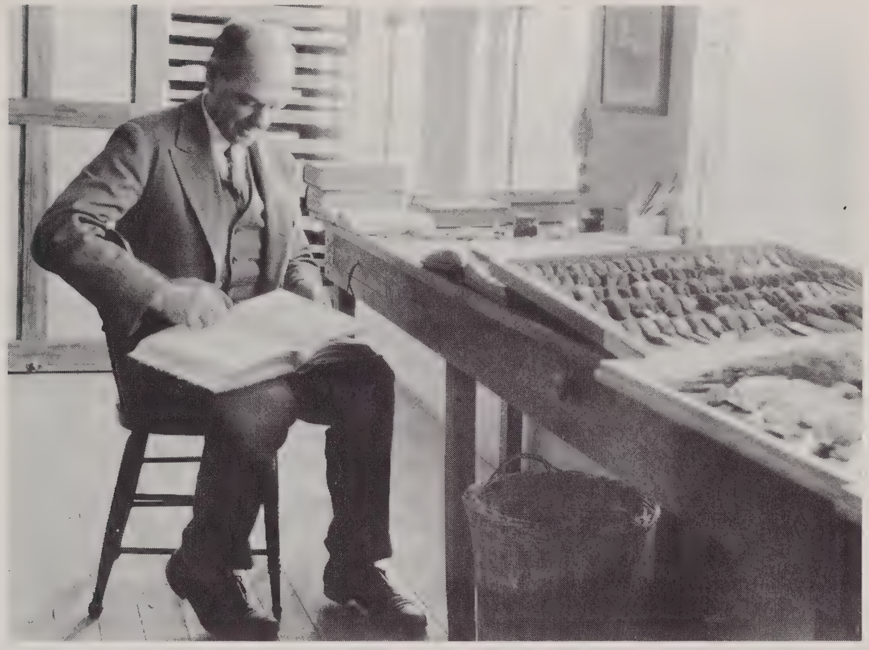

Fig. 3. Outram Bangs, Curator of the MCZ Bird Department, 1919-1932. This undated photograph shows Bangs at work in the MCZ with some of the important tools of his trade: reference books and bird skins. The author of hundreds of taxonomic publications, Bangs lacked formal education in ornithology and served the MCZ in an honorary capacity. Although not officially appointed Curator of Birds until 1919, Bangs assumed care of the MCZ bird collection around 1900, and with the aid of Thomas Barbour and numerous other generous patrons, guided it through its most active period of expansion. Photograph courtesy of Museum of Comparative Zoology, Harvard University.

By the time Bangs sold his mammal collection to Harvard in 1899, he had once again become interested in birds. For the rest of his life he cooperated closely with his longtime friend, John Eliot Thayer, a fellow Harvard graduate (class of 1885), son of the generous MCZ supporter Nathaniel Thayer, and an important MCZ patron himself (Annual Report 1909:4; Anon. 1933; Phillips 1933-1934, 1934). Thayer was primarily interested in North American birds, and Bangs, Central American. The two sponsored numerous collectors in both regions and occasionally worked up their results together (Peters 1933:269, Porter 1943:115). In 1908 Bangs presented his beautifully prepared bird collection, numbering 24,000 specimens and about 200 types, to the MCZ. Over the next 25 years, Thayer proved equally generous, serving for over two decades as a member of the governing faculty of the MCZ, sponsoring regular collecting expeditions on behalf of the Museum, and donating a magnificent collection of North American birds, which totaled over 28,000 specimens. Thayer's ornithological collection, which he formally turned over to the MCZ in 1931, included a number of exquisitely mounted specimens used to replace the aging Greene Smith exhibit collection.

Bangs and Thayer soon attracted numerous other enthusiastic patrons to support the newly reinvigorated MCZ Bird Department. One of the most important was John Charles Phillips, who received his bachelor's degree from the Lawrence Scientific School in 1899 and his M.D. degree from Harvard Medical School five years later (Anon. 1938a,b; Griscom 1938; Allen 1939a,b; Barbour 1939; M[urphy] 1939). Phillips never practiced medicine professionally. Instead he spent much of his time traveling around the world to hunt trophies for his home and specimens for the MCZ. He also worked on behalf of several conservation organizations (including the American Committee for International Wild Life Protection, which he helped found in 1930 [Anon. 1930]). And he published on a variety of subjects ranging from eugenics to systematics (Phillips 1932). His most important publication was *The Natural History of Ducks* (1922-1926), a four-volume work that Thomas Barbour (1939:[11]) pronounced "probably the best monograph of its kind which has been done by any American naturalist." But like most other publications issued by MCZ-affiliated ornithologists during this period, Phillips' exquisitely illustrated book harkened back to nineteenth-century traditions more than it reflected twentieth-century innovations.

Other ornithologists also became formally or informally affiliated with the MCZ Bird Department during this renaissance period. Among these was Thomas Edward Penard, an MIT-educated electrical engineer and expert on the birds of his native Surinam (Peters 1937). Penard, who first volunteered at the MCZ in 1917, published over 30 papers on the taxonomy of tropical American birds (most co-authored with Bangs) before selling his collection of over 2000 skins to the MCZ in 1930. Frederic Hedge Kennard, a well-known Boston landscape architect and graduate of Harvard College, first volunteered to work at the Museum in 1919. Seven years later he placed his collection of 5000 North American skins on permanent deposit (Peters 1936, Allen 1937, Bent 1937). That same year, Arthur Cleveland Bent, a graduate of the Harvard Class of 1889 and a Taunton, Massachusetts, businessman best remembered for his multi-volume series on the life histories of North American birds, placed his collection of 12,000 North American skins on deposit at the MCZ (Teale 1946, Taber 1955, Banks 1969). In 1933 Charles Foster Batchelder, Harvard College graduate (1878), pioneering member and long-time treasurer of the Nuttall Ornithological Club, and editor of the *Proceedings of the New England Zoological Club*, turned over his collection of over 9000 skins to the MCZ (Annual Report 1933:26, Root and Elkins 1973:17). Under the leadership of Outram Bangs and John Thayer, Alexander Agassiz's earlier calls for Harvard alumni to support the MCZ were bearing fruit in the form of a greatly augmented bird research collection.

Another important source of bird specimens was the Boston Society of Natural History (BSNH), which was undergoing a metamorphosis toward the end of the nineteenth century. The organization, which had served as an important scientific society since its founding in 1830, was gradually being transformed into a public museum (Kohlstedt 1979). Reflecting this reorientation, in 1914 BSNH officials decided to transfer most of the research collection to the MCZ. The Bird Department received the historic Lafresnaye collection that Henry Bryant had donated to the BSNH in 1865 (Bouvé 1880, Penard 1945). The Society also transferred remnants of the Charles Willson Peale collection, which had served as the basis for a number of early American ornithological publications, including Alexander Wilson's *American Ornithology* (1808-1814) (Faxon 1915). Both collections were invaluable, but the Lafresnaye collection, which contained over 300 type specimens, was particularly rich (Bangs 1930:147-149).

Following William Brewster's death in 1919, the MCZ also became the beneficiary of his vast collection of North American bird skins, mounts, nests, and eggs. The Brewster skin and mount collection, which numbered approximately 40,000 specimens, was the largest single ornithological collection ever received by the MCZ. Brewster also passed on his extensive ornithological research library (1701 volumes), a large series of manuscript journals (portions of which were later edited for publication, Brewster 1924-1938, 1936, 1937), and a $60,000 endowment for the Bird Department (Annual Report 1920:4-6). According to the terms of the bequest, the money was to be used to purchase "desirable specimens which are from time to time offered for sale."

The generous Brewster bequest set into motion a series of closely related, long-term projects that were to be among the most important in the Bird Department's history. Spurred on by the continued support of wealthy patrons and the encouragement of fellow MCZ Curator Thomas Barbour, Bangs began an ambitious program to acquire representatives of all the known genera and species of birds of the world. When he began this effort around 1920, the Museum had already amassed an impressive 2304 of the 2647 genera contained in the most recent compilation of the birds of the world, Richard Bowlder Sharpe's *Hand-list of the Genera and Species of Birds* (1899-1912) (Annual Report 1920:8).

Annual Reports over the next 12 years record Bangs' remarkable progress in obtaining previously unrepresented examples for the MCZ collection. By the time of his death in 1932, the bird collection contained over 250,000 skins, 1316 types, approximately 65% of the known forms, and all but 49 of the Sharpean genera (Bangs 1930:147-149; Peters 1933:133; for additions over the next decade, see Peters 1943). The MCZ collection was then the third largest in the United States, far behind the American Museum of Natural History in New York (which had just secured the vast Rothschild Collection) but almost identical in size with the U.S. National Museum in Washington (Peters 1933). The push to fill the gaps in the MCZ bird collection also led to two other ambitious and closely related projects: a comprehensive catalog and a new published checklist of the birds of the world (discussed below).

A final event that occurred during Outram Bangs' tenure deserves mention: the ascendancy of Thomas Barbour to the directorship of the MCZ in 1927. Six-foot-six and over 300 pounds in his prime, Barbour was an imposing figure, overpowering in size and personality. Barbour did for the MCZ as a whole what he, Bangs, and his associates had already begun to do for the Department of Birds. After 17 years of decline under the directorship of Alexander Agassiz's successor, Samuel Henshaw, Barbour revitalized the MCZ with a fresh infusion of funds, ideas, and specimens.

Legend has it that Barbour first visited the MCZ at age 15, when he was brought to Cambridge by a friend of his father (Barbour 1943b, 1946; Peters 1948; Bigelow 1950; Romer 1964, 1974). He is supposed to have immediately fallen in love with the place and made up his mind that someday he would become its Director. After earning his A.B. from Harvard in 1906, he married and traveled extensively in the East Indies for his honeymoon. There he completed the fieldwork that became the basis for his Ph.D. dissertation on the biogeography of the region (Barbour 1910). Finished under the direction of E. L. Mark, Barbour's was one of the few Harvard zoological dissertations from this period not primarily focused on physiology, histology, embryology, or genetics. Many other young men, like Reuben M. Strong (1901) and Leon J. Cole (1906), came to graduate school at Harvard with a strong interest and background in traditional natural history only to find themselves assigned to do research in topics more consistent with the goals and methods of the new biology (Rand 1966, Chapman 1990). Barbour's success at resisting this pressure is testimony to the stubborn determination he exhibited throughout his life. Following graduation, Barbour was appointed Associate Curator (1910) and then Curator (1925) of Reptiles and Amphibians at the MCZ. He also became one of MCZ's most important patrons, donating money and specimens, sponsoring collectors, and venturing into the field himself on behalf of the Museum.

Although his ostensible area of expertise was herpetology, Barbour was also keenly interested in birds. He was particularly well-versed in the avifauna of Cuba, the subject of two of his numerous books (Barbour 1923, 1943a). There he helped make what his eulogist has described as "one of the last of the really great ornithological discoveries in neotropical America" (Peters 1948:435). During one of his frequent trips to the island in the mid-1920s, he heard rumors of strange birds inhabiting the unexplored areas of the vast Zapata Swamp. Barbour arranged for the Cuban naturalist Fermin Cervera to investigate the reports. Cervera eventually found three new bird species—*Ferminia cerverai*, *Torreornis inexpectata*, and *Cyanolimnas cerverai*—that Barbour (1926, 1928) and Barbour and Peters (1927) quickly described. Although he was in Philadelphia at the time specimens of the latter two birds arrived at the MCZ, Barbour worked out their generic diagnoses and plumage descriptions over the telephone with Peters. The paper describing the two new species appeared in the *Proceedings of the New England Zoological Club* by the time Barbour returned to Cambridge a few days later!

Unlike his immediate predecessor, Samuel Henshaw, Barbour possessed both the vision and the means to begin restoring the MCZ to the exalted status it had previously enjoyed under Louis and Alexander Agassiz. When he became Director of the Museum in 1927, one the first items on Barbour's agenda was extensive renovation of the archaic MCZ complex. He modernized the building by securing electric lights to replace the inadequate and dangerous gas lamps, an electric elevator to replace the old and unreliable hand-drawn model, and interdepartmental telephones to improve communication. He floored over several of the large old museum galleries to provide badly needed work and storage space. And he began sprucing up the aging exhibit collections.

To aid him in executing his reforms, in 1927 Barbour hired Ludlow Griscom as his administrative assistant. Griscom came to the MCZ with a master's degree in ornithology from Cornell (where he was Arthur Allen's first graduate student) and a decade of experience at the American Museum of Natural History (Teale 1945, Baker 1959, Peterson 1965, Sterling 1980, Davis 1994). While living in New York, he had perfected a system of "split-second" field identification that became the inspiration for Roger Tory Peterson's legendary bird field guide, first published in 1934 (Peterson 1965:601). In Cambridge, Griscom continued to practice and promote field identification whenever he found the time, but he also completed a number of specimen-based faunistic and taxonomic studies of Latin American birds, a monographic study on the Red Crossbill (*Loxia curvirostra*), and a series of local avifaunas. In addition, he assumed administrative positions for several scientific and conservation organizations, most notably the Massachusetts Audubon Society, the National Audubon Society, and the American Ornithologists' Union. But his principal responsibility for the next two decades was supervising the day-to-day operation of the MCZ, especially its active publication program.

As part of his reform campaign at the MCZ, Barbour also moved to reintegrate the biological teaching and curatorial functions that had become so divided at Harvard during the previous 50 years. In an attempt to reverse that trend, soon after assuming office he arranged to have himself and four other MCZ curators appointed to the Harvard Faculty of Arts and Sciences in order to allow "a few selected students of advanced standing" to profit from the specimens and personnel at the Museum (Annual Report 1928:7). Several years later he also offered associate curatorial status at the MCZ to appropriate faculty in the Biology Department (Annual Report 1932:9). The completion of Harvard's new Biological Laboratories building in 1932—financed with a generous grant from Rockefeller's General Education Board—meant that biological teaching at Harvard was to occur largely outside the doors of the MCZ (Parker 1932). But Barbour worked to insure that the institution under his charge once again became an important center for advanced zoological training.

Within five years of taking over the MCZ, Barbour declared optimistically that "Louis Agassiz's original plan that Curators in the Museum should receive a few students interested in their specialties is working extremely well" (Annual Report 1932:9). In making this claim Barbour either failed to appreciate or refused to acknowledge a key difference between the early days of the MCZ—when student-assistants served in all but name as full curators of the collections—and his plan of encouraging students working on advanced degrees to study and work at the MCZ under the supervision of its more experienced curators. Despite this important difference, the renewed stream of advanced students through the halls of the MCZ meant the institution was once again to be reinvigorated with the enthusiasm and talent of bright young minds.

Continuity and Reorientation: The James Peters Years (1932-1952).—During the academic year of 1932-1933, when the nation was in the grips of its deepest depression in history, the MCZ Bird Department was struck a double blow. The two lifelong friends who had helped bring the MCZ collection to a level of truly international importance—Outram Bangs and John E. Thayer—died within eight months of one another. James Lee Peters, who lacked advanced education in biology, but who had long served as Bangs' apprentice, was waiting in the wings to continue the Department's ambitious acquisition and publication programs.

Like many ornithologists, Peters' interest in birds had begun at an early age (Wetmore 1957). With the support of his father, a prominent veterinary surgeon, he soon came into contact with C. J. Maynard and A. C. Bent, both of whom further encouraged his efforts. While an undergraduate at Harvard, Peters also discovered Outram Bangs, who was to exert a lasting influence on the young man. Except for a two-year stint in the Army

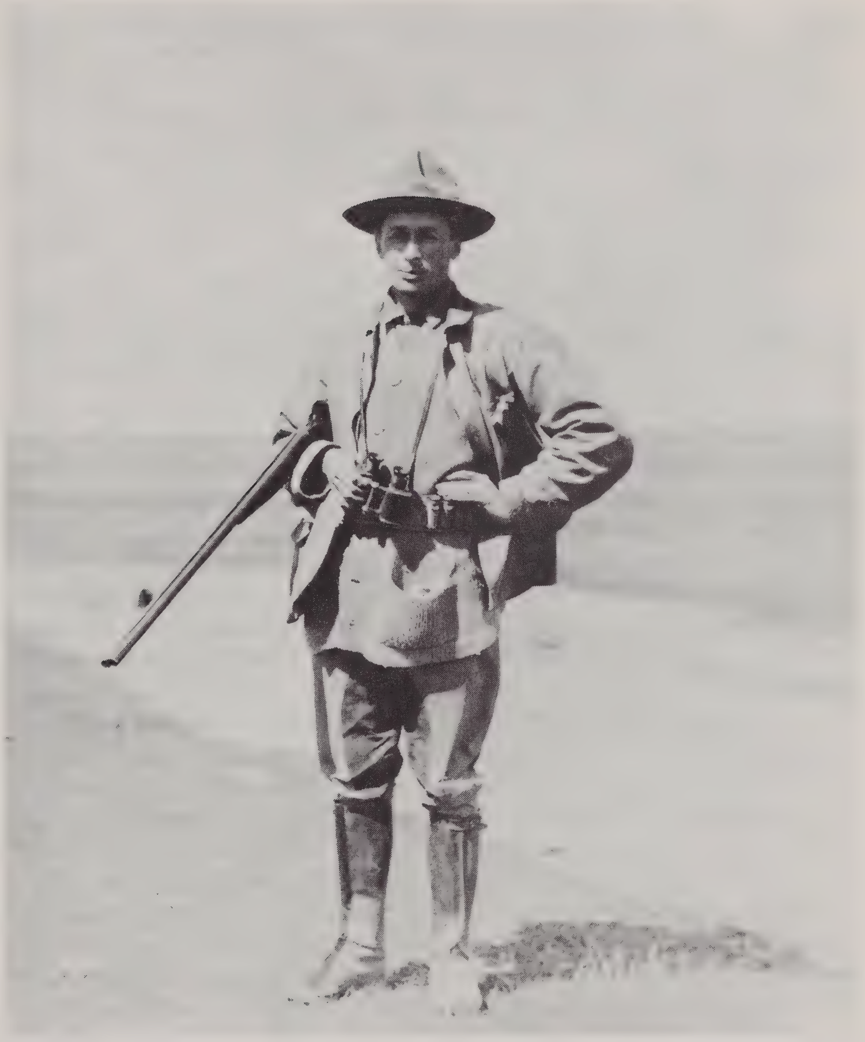

Fig. 4. James L. Peters, Curator of the MCZ Bird Department, 1932-1952. This photograph was taken in Argentina in the 1920s, when Peters was in the field on behalf of the MCZ and the U.S. Bureau of the Biological Survey. Later his curatorial duties and work on the monumental *Check-list of the Birds of the World* kept him closer to home. Peters lacked formal training in ornithology and relied on the income from his apple orchard to supplement the meager salary he received from the MCZ. Photograph courtesy of Museum of Comparative Zoology, Harvard University.

during World War I, for over a decade after receiving his A.B. degree in 1912, Peters spent much of his time in the field under the auspices of the MCZ and the U.S. Bureau of the Biological Survey. One of his most important expeditions during this period was a year-long trek through Argentina sponsored by John C. Phillips, then in the midst of gathering material for his monograph on ducks. In 1921 Peters returned from South America laden with 1250 bird skins. He also brought back an enduring nickname, "Patagonia Pete," coined by the Smithsonian ornithologist Alexander Wetmore, with whom he had spent two months in the field. Upon his return Peters received appointment as an Associate at the MCZ. He was promoted to Assistant Curator in Ornithology in 1928, and then following the death of Bangs, to Curator. He held the latter post until his own death two decades later.

Although he came to office in the midst of the Great Depression, Peters was initially able to maintain the ambitious acquisition program begun by Bangs. In his first five years as Curator, the MCZ received an average of 4358 bird specimens each year through donation, exchange, purchase, and museum-sponsored expeditions (Annual Report 1939:24). But then the level of acquisitions dropped suddenly and dramatically, never to fully recover. Since World War II, MCZ bird curators have focused more on caring for and researching existing specimens than acquiring new ones.

A number of factors account for this permanent decline. The first was the phenomenon of diminishing returns. As early as 1936 Peters claimed that the MCZ bird collection was reaching a point where it was becoming increasingly difficult to fill the remaining gaps (Annual Report 1936:27-29). In most areas of the world, general collecting was more and more unlikely to yield unrepresented species, many of which were quite rare. As a result, the two other most common means of acquiring desiderata—purchase and exchange—were also unlikely to be fruitful. By 1943 Peters reported that "it appears that we are now reaching the vanishing point for species, a condition reached in genera several years ago" (Annual Report 1943:13).

Other problems compounded the general difficulty in locating unrepresented specimens. During World War II collectors and curators were often called to serve in the military, travel was disrupted, and troops occupied important collecting grounds. The year after the war ended, Thomas Barbour, one of the Department's most generous patrons for the previous 40 years, died, and MCZ curators and administrators failed to recruit a new generation of supporters to sponsor collectors or purchase needed material. Post-war inflation greatly increased the cost of mounting expeditions, while Harvard College continued to refuse to fund the MCZ adequately. The rise of nationalism and the growth of conservation sentiment in developing nations, the habitat of most desiderata, also curtailed collecting opportunities.

Many of these problems were not unique to the MCZ. Yet, with adequate funding and determination, other museums continued to build impressive bird collections despite the many obstacles. For example, in 1933 the University of Michigan Museum of Zoology bird collection contained just over 33,000 specimens. By 1973 that number had grown to 200,000. During this same 40-year period, the Field Museum of Chicago bird collection grew from 97,000 to 300,000 birds and the American Museum bird collection grew from 685,000 to 900,000 (Peters 1933; Banks et al. 1973, see chapters 5 and 6 this volume). Clearly continued growth was possible.

In addition to the numerous factors already suggested, the MCZ's failure to maintain its strong acquisition program after the war was related to a push to complete the *Check-list of Birds of the World* (Peters 1931-1987). The beginning of this project dates back to 1919, when the Department received the generous Brewster bequest and Bangs announced that he was seeking specimens representing as many genera and species of the world as possible for the MCZ. In an effort to keep better track of exactly which species and genera were already in the collection, in 1923 Bangs assigned Peters the task of initiating a comprehensive card catalog of the birds of the world. Each entry included information on newly discovered forms, synonymy, name changes, and other pertinent data for species currently in the MCZ collection and on its want list. It is not known with certainty who deserves credit for the card catalog idea, but it is most likely Thomas Barbour, who apparently began a similar catalog in the Department of Reptiles and Amphibians (Paynter 1987:v, Bock 1990:634).

Initial estimates about how long the card catalog project would take soon proved naively optimistic. When Peters began with the first entries in 1923, he believed he would finish within five years. However, he quickly realized that he might spend the rest of his life trying to complete all the entries. In the late 1920s Peters secured the aid of several assistants including one, Margaret D. Porter, who was appointed a Research Associate in the Bird Department. The project continued in earnest until the mid-1940s, when it was largely abandoned. All work on the card catalog ceased in 1961 (Bock 1990:633).

Peters soon initiated an even more ambitious spin-off project from his work on the card catalog. He recognized that the catalog might become the basis for a new comprehensive list of the birds of the world to replace Sharpe's obsolete *Hand-list.* In late January 1929 Peters revealed to his close friend, Alexander Wetmore, that he had begun compiling such a list and that the manuscript for the first volume was already 3% completed (Bock 1990:635). By October of 1931 he had seen volume I of the *Check-*

list of Birds of the World through press. Six subsequent volumes appeared under his name at roughly three-year intervals. Although Peters devoted more and more of his time to the project over the years, at the time of his death in 1952, it was still only about one-third complete.

During this period, Thomas Barbour's effort to encourage graduate study at the MCZ also began to bear fruit. For the first time graduate students doing research toward advanced degrees in ornithology used MCZ bird collections and worked under the supervision of MCZ personnel. The most important advisor for graduate students on matters ornithological during the 1930s and early 1940s was Glover Morrill Allen (no relation to J. A. Allen), one of the five MCZ curators for whom Barbour obtained senior appointments in the College of Arts and Sciences after becoming MCZ Director.

Glover Allen first began working part-time in the MCZ Mammal Department in 1907, three years after he earned his Ph.D. in zoology at Harvard (Clark 1942, Barbour et al. 1943, Tyler 1943, Lawrence 1947, 1973). In 1924 he resigned from the position of Secretary of the Boston Society of Natural History in order to become Curator of the MCZ Department of Mammalogy and Lecturer in Zoology. Although hired as a mammalogist, Allen was equally adept in ornithology. For several years after his MCZ and Harvard College appointment, he taught an undergraduate course on birds (see Allen 1925). His ornithological achievement was also recognized with election to presidency of the Nuttall Ornithological Club following the death of William Brewster in 1919 and to editorship of *The Auk* in 1937. He held both positions until his death in 1942, at the age of 62. Although somewhat reserved, Allen gave freely of his time to encourage young naturalists. As one of his colleagues wrote of him, "He was never too busy to help a student" (Barbour et al. 1943:301). Among those who benefitted from Allen's generosity and knowledge were several individuals who completed doctoral degrees in ornithology at Harvard during this period: Oliver Austin (1931), David Davis (1939), Donald Griffin (1942), and S. Dillon Ripley (1943).

Yet, even with Barbour and Allen's encouragement, the MCZ failed to become an important graduate center in ornithology on the scale of other major universities like Berkeley, Cornell, or Michigan. By 1933, 11 American universities offered graduate degrees in ornithology, and 39 students were enrolled in these programs. Seven of these graduate students were at Berkeley, 21 at Cornell, and three at Michigan. Not one was at Harvard (A. A. Allen 1933, Mayr 1975:375). Two of the three schools with the most active graduate programs in ornithology—Michigan and Berkeley—also had impressive museums and active accession programs (Peters 1933, Banks et al. 1973).

A number of factors explain Harvard's failure to establish itself as a leader in graduate education in ornithology. First, was the longstanding rift between teaching and museum curation that had begun in the days of Alexander Agassiz. E. L. Mark and his successor, George H. Parker, largely controlled Harvard's zoological program between 1877 and 1934. Both had advanced training from German universities and both were more interested in laboratory-based biology than the taxonomic and biogeographic studies that had been typical of museum-based zoology. As many as 300 graduate students majored in zoology and about 100 of these earned Ph.D.s during the years that Mark and Parker were in charge of the Harvard program (Morison 1930:459, Parker and Crozier 1930, Parker 1946, Romer 1948:15). But with few exceptions, even those students who came to Harvard with an interest in natural history were steered away from taxonomic studies, and there was no countervailing force within the MCZ pulling in the other direction.

Exacerbating this division was the MCZ's failure to recruit ornithological curators who had themselves earned advanced degrees. Although affiliated with one of the nation's premier universities, the MCZ as a whole, and especially the Bird Department, proved to be an exception to the early twentieth-century trend toward requiring the Ph.D. to enter the profession of science. For most scientific disciplines, a doctorate had become the standard entry-level degree by 1910 (Kohler 1990), yet it was not until over four decades later that MCZ officials hired the first Bird Department staff member with a Ph.D. in ornithology. Bangs, Peters, and the numerous gentleman-naturalist-patrons they had gathered around them had been more interested in collection development and taxonomic research than providing an opportunity for advanced training in ornithology. The apprenticeship system in place at the MCZ—whereby curators were invariably replaced by their former assistants, no matter what their level of education—produced competent curators and researchers who were capable of describing new species, engaging in nomenclatural controversies, and publishing collection catalogs. But it did not produce the kind of scientists interested in broader biological questions or qualified to supervise graduate students.

No doubt the MCZ's continuing fiscal difficulties were a major factor in the failure to attract bird curators with advanced degrees. With the exception of Peters, the curators of the Bird Department between William Brewster (appointed in 1885) and James C. Greenway, Jr. (appointed in 1952), were all from well-to-do families, and all served in honorary capacities. Peters was paid for his work at the MCZ, but his income from the position was so meager that he was forced to spend much of his time tending his apple orchards in Harvard, Massachusetts (Mayr, pers. comm.).

Toward the end of the Bangs era and throughout the Peters years, the MCZ egg and nest collection finally received attention. Oology had never been pursued with zeal at the MCZ. In part because of its association with youthful collecting and in part because oologists seemed more interested in amassing specimens than in engaging in serious research, the field had long been considered a stepchild of scientific ornithology. But in addition to other miscellaneous specimens acquired over the previous seven decades, the MCZ possessed two large collections of North American birds and nests donated by William Mayo Brewer and William Brewster. In 1928 the naturalist Winthrop Sprague Brooks was appointed the first "Custodian of Birds' Eggs and Nests" for the MCZ, a position he held for the next six years. Brooks, who was also a Curator of Birds at the Boston Society of Natural History, cleaned, arranged, labelled, and cataloged the previously neglected MCZ collection, which after Thayer's donation of 15,000 specimens in 1931, numbered "a trifle over 35,000 eggs" (Annual Report 1932:42-43). In 1934 Richard Creslow Harlow, the Harvard football coach, took charge of the MCZ egg and nest collection and remained its nominal caretaker for the next 24 years. In 1943 he gained the assistance of the Boston businessman William George Fowle Harris, who remained Associate Curator of Oology at the MCZ until 1969 and Associate in Ornithology until 1971, one year before his death.

Three other individuals became affiliated with the MCZ during the Peters years. The first was John Augustus Griswold, Jr., an enthusiastic young collector and "research assistant" who first came to the MCZ in the mid-1930s and remained until 1941, when he left to enroll in the graduate program at Cornell. Griswold later became Curator of Birds at the Philadelphia Zoological Garden, where he won an award from the Department of Interior for the first successful breeding of the Trumpeter Swan in captivity (Root and Elkins 1973:40). The second was Thomas Tonkin McCabe, a graduate of Harvard (B.A. and M.A.) who was granted the title of Associate in Ornithology in 1937 after donating his collection of nearly 6800 birds, mainly from British Columbia (Howard 1950). And finally, James Conway Greenway, Jr., came to the MCZ in 1932 as an Associate Curator in Ornithology. As the senior member of the MCZ ornithological staff, it was he who was chosen to become Curator of the Department of Birds when James Peters died suddenly in 1952.

Interlude: The James C. Greenway Years (1952-1960).—James Conway Greenway, Jr., is the most enigmatic figure ever to become a Curator of Birds at the MCZ. Although a competent ornithologist, he was, in the words of his memorialist François Vuilleumier (1992:380), "a profoundly eccentric man." Greenway abhorred crowds so much that he refused to attend scientific meetings. He was so secretive that after his death his colleagues and even his own children remained ignorant of important details concerning his life. And he left the MCZ after serving as Curator of Birds for only eight years, the shortest period for the position since the early days when Louis Agassiz relied on students to care for his collections.

Like several previous MCZ bird curators, Greenway was born into a wealthy family. After graduating with an A.B. degree from Yale University in 1926, he apparently began working as reporter for a Brooklyn newspaper. Three years later he accepted an invitation from the French ornithologist Jean Delacour to accompany a collecting expedition to Madagascar. The two men soon became close friends, and Greenway subsequently participated in, and often helped fund, numerous other international expeditions. Though lacking in formal ornithological training, in 1932 Greenway joined the staff of the MCZ Bird Department. One year later he published his first scientific paper on the birds of Yunnan (1933). Greenway's career was disrupted by World War II, during which he served aboard an aircraft carrier in the southwestern Pacific.

When he returned to the MCZ after the war, Greenway became increasingly involved with bird conservation initiatives. His extensive knowledge of the causes and consequences of avian population decline culminated in the pioneering book, *Extinct and Vanishing Birds of the World* (1958), published by the American Committee for International Wild Life Protection. The book had its origins in two card catalogs of threatened species begun by American Committee founders John C. Phillips and Thomas Barbour, who encouraged Greenway to keep the list up to date (Phillips 1929, Phillips and Coolidge 1934, Greenway 1958:v). Greenway also became an important behind-the-scenes supporter of the International Committee (later Council) for Bird Preservation (ICBP), which had been organized in 1922 (Pearson 1937:383, Vuilleumier 1992:379).

When James Peters died in 1952, MCZ Director Alfred Romer (who had succeeded Barbour six years previously) declared that the completion of the *Check-list* would remain one of the Museum's highest priorities (Annual Report 1952). As the newly appointed Curator of the MCZ Department of Birds, it fell to the reluctant Greenway to continue the daunting project. Greenway—who had not been involved with the venture up to that point—was apparently relieved when Harvard officials negotiated for the internationally renowned ornithologist and evolutionary biologist Ernst Mayr to come to Cambridge as Alexander Agassiz Professor of Zoology in 1953 (Gould 1984, Anon. 1985). Although Mayr was not officially connected with the Bird Department, his fifth-floor office was immediately adjacent to the collection, and Greenway soon approached him about co-directing the project. Mayr agreed and assumed responsibility for the basic decisions regarding completion of the *Check-list* (Bock 1990:637).

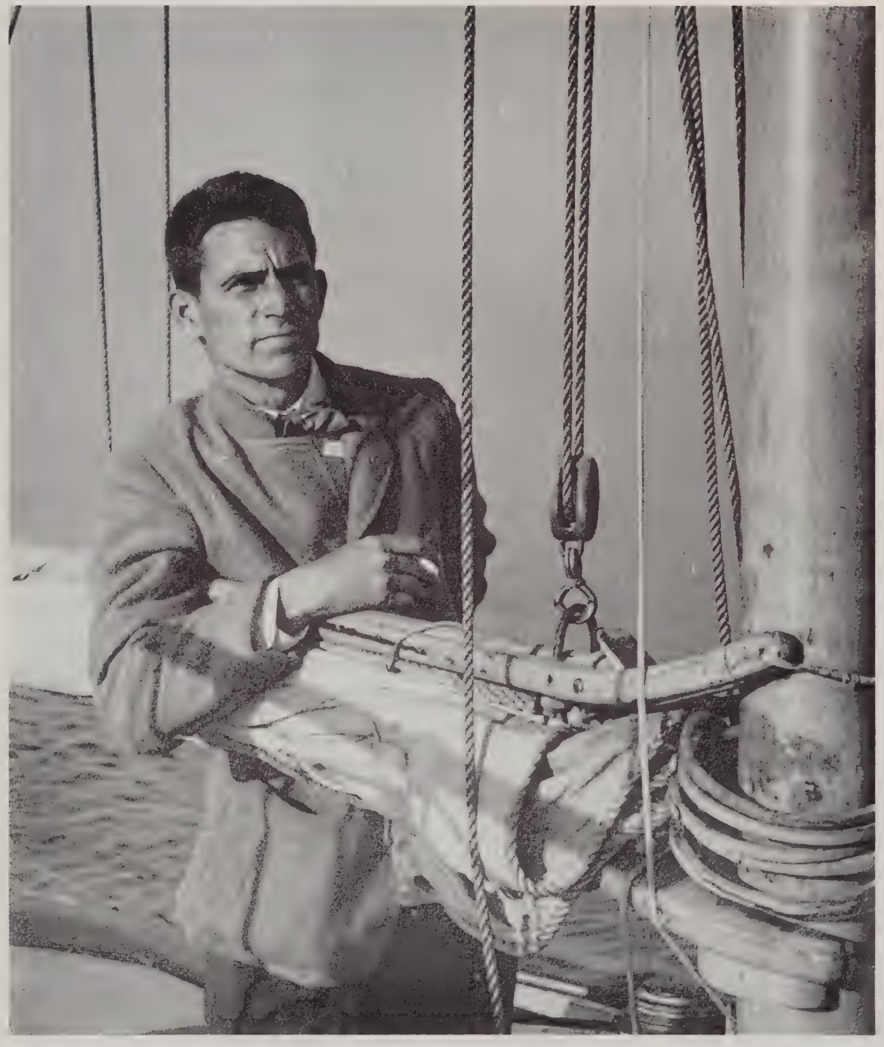

Fig. 5. James C. Greenway, Jr., Curator of the MCZ Bird Department, 1952-1960. This photograph was taken in 1946. Greenway, who came to the Bird Department in 1932, is probably best remembered for his eccentric personality and his pioneering work on bird conservation. Although he lacked formal training in science, MCZ officials appointed him Curator of Birds following the death of J. L. Peters in 1952. He was the last of the gentlemanly specialists to serve in that capacity. Photograph courtesy of David Greenway.

Both men recognized the wisdom of not trying to finish the remaining volumes themselves. Toward the end of his life, even Peters had begun tentative steps in this direction when he arranged for his friend John Todd Zimmer (at the American Museum of Natural History) to write the section on Tyrannidae and related New World families. Mayr and Greenway solicited an international team of avian systematists to prepare manuscripts for each family or in some cases, parts of a family. What had been a single-author compilation was eventually completed with the aid of 33 additional authors and editors from around the world (Paynter 1987:vi).

Following the decision to continue the work with multiple authors, in 1953 Romer issued the optimistic prediction that Peters' *Check-list* would be completed "within a short term of years" (Annual Report 1953). However, for a variety of reasons, the next installment failed to appear until 1960 and the final volume of text was not published until 1986, 26 years later. The publication of a comprehensive index in 1987 marked the formal completion of the project (Paynter 1987). In addition to Mayr and Greenway, Melvin A. Traylor, Jr., Curator of Birds at the Field Museum in Chicago, G. William Cottrell, an Associate in Ornithology at the MCZ, and Raymond A. Paynter, Jr., served as editors of the remaining volumes and a revised edition of Volume I. The 16-volume *Check-list of the Birds of the World*—which required a total of nearly six decades to complete—represents one of the most important legacies of the MCZ Bird Department. According to Mayr (1975:369), there is no reference work like it for any other group of animals.

Following his divorce, Greenway left Cambridge in 1960 to return to his family estate in Greenwich, Connecticut. He resigned his position at the MCZ and apparently never set foot in the building again, although he did become an active researcher and patron at the American Museum of Natural History in New York.

The Modern Period: The Early Raymond Paynter Years (1960-ca. 1970).—Raymond Andrew Paynter, Jr., was the logical choice to succeed Greenway. He had been hired as an Assistant Curator in 1953, the same year that Ernst Mayr came to Harvard and MCZ Director Alfred Romer announced that every museum department ought to have at least a full-time senior curator and "a younger man in training to take over on his senior's retirement." Apparently these three events were linked by the final settlement of the estate of George R. Agassiz, the son of Alexander Agassiz, which provided a fresh infusion of badly needed funds for the MCZ (Annual Report 1953). One year after he came to the MCZ, Paynter was awarded his Ph.D. at Yale University for a dissertation on the birds of the Yucatan Peninsula. The first staff member of the MCZ Bird Department to earn a doctorate in ornithology, he was quickly promoted to Associate

Curator of Birds in 1956 and, following the departure of Greenway, to Curator in 1960.

In addition to all the responsibilities associated with curating the fourth largest ornithological collection in the United States (Banks et al. 1973), publishing his own research, and initiating an undergraduate course in bird biology, Paynter has been central to a number of important publication projects based at the MCZ. When he assumed office in 1960, one of his tasks was helping to edit and otherwise see through press four of the remaining volumes and the index for the *Check-list of Birds of the World.* He also authored sections on several of the families. Before this project was brought to final completion, Paynter initiated another large multi-authored publication: a series of ornithological gazetteers of South America. Between 1975 and 1991, he and his collaborators—Melvin A. Traylor, Jr., Blair Winter, David Rand, and Lorain Stephens—issued 11 volumes covering about 25,000 locations across the South American continent. He also continued to cultivate the historically close relationship between the Nuttall Ornithological Club and the MCZ by serving in a variety of offices for the organization, including president (1960-1963, 1972-1973) and editor (1966-present) of the Club's publications.

With arrival of Paynter and Mayr, the MCZ once again began to produce professionally trained ornithologists. Between 1955 and 1975, the year Mayr became Professor Emeritus, at least a dozen students—including James A. Keast (1955), Andrew J. Meyerriecks (1958), Walter J. Bock (1959), Carl W. Helms (1960), Terrell H. Hamilton (1960), W. John Smith (1961), François Vuilleumier (1967), Susan T. Smith (1968), John Alcock (1970), Robert E. Jenkins, Jr. (1970), George Lester Hunt (1971) and M. Ross Lein (1974)—completed doctoral dissertations on birds at Harvard. Mayr was clearly the most important influence on these students—who went on to active careers in biology departments, museums, and conservation organizations across North America—but in many cases Paynter and other MCZ staff also contributed to their intellectual development. Although the number of Harvard Ph.D.s in ornithology was still relatively modest compared to the most active programs in this country, it was about three times as many as had been awarded in the entire previous century.

In 1961 Ernst Mayr became the Director of the MCZ. A man of forceful opinions and penetrating insight, Mayr was determined to reinvigorate the institution much as Thomas Barbour had tried to do when he came to that same office over four decades previously. Yet it was to be an uphill battle. Museum-based systematics, which had been the raison d'etre of the MCZ since its founding, had been on the defensive since the end of the nineteenth century, when experimental biology had begun to displace it (Allen 1978, Pauly 1984). Mayr came to office during the early stages of one the most recent and perhaps gravest threats to biological systematics.

The emergence of the field of molecular biology—with its promise to unlock the secrets of life—drew away prestige, funds, and the best graduate students from the more traditional, museum-based field of systematics. Ironically, molecular biology was propelled into the spotlight with Watson and Crick's discovery of the helical structure of DNA in 1953, the same year Mayr had come to Harvard from the American Museum.

In the face of this growing threat, Mayr did everything in his power to ensure the continued well-being of the field of systematics more generally (e.g., see Mayr 1961, 1968) and the MCZ specifically. During his nine years as MCZ Director, he worked to improve the quality and status of the curatorial staff, to place increasing emphasis on teaching (especially at the graduate level), and to expand the MCZ complex, which as Mayr was fond of pointing out, was exactly the same size as when Alexander Agassiz had finished the final wing (Annual Report 1970:6-8). He was at least partially successful on all three fronts. By 1969, 16 MCZ staff members were offering regular courses at Harvard, 14 were members of the Faculty of Arts and Sciences, and 47 students were pursuing graduate degrees in the MCZ or under the direct supervision of MCZ staff (Mayr 1969:5-7). In order to house the growing faculty, staff, and collections more adequately, Mayr began a campaign to finance a new wing for the MCZ, which was finally completed in 1973. He also arranged for the purchase of the Concord Field Station, a 700-acre research facility secured with a matching grant from the Ford Foundation in 1967.

Despite these tangible gains, as is clear from the tone of a document Mayr issued in his penultimate year as Director (1969), MCZ curators remained at the bottom of the pyramid that was clearly dominated by Harvard's Department of Biology. The existence of a large endowment, which in 1969 supplied 93% of the MCZ's income, was probably the only thing that kept this historic institution from being subsumed entirely by that Department or perhaps lost altogether.

Conclusion.—Soon after his arrival in the United States, Louis Agassiz set out to establish a new kind of institution at Harvard. The MCZ was to be different from the typical nineteenth-century museum which was devoted to gathering and preserving specimens for public exhibition or (less frequently) private research. Although these activities were to be important, what most distinguished the MCZ from contemporary institutions was its colossal scale and Agassiz's desire to use his museum to promote the professionalization of natural history.

Until recently the MCZ Bird Department, like the larger institution of which it forms a part, has generally failed to live up to the ambitious promise contained in Agassiz's original vision. Rather than promote the gainful employment of scientific ornithologists, serve as a center for truly innovative research, or provide advanced scientific training, the Bird Department has been staffed largely by gentlemanly practitioners who have pursued quite traditional taxonomic studies.

Even so, the Department has managed to achieve a great deal during its first century. Its most enduring legacy is, of course, the research collection of birds, one of the largest and most comprehensive in the United States. Over the years, this irreplaceable resource has provided the specimens for hundreds of ornithological publications, including many authored by MCZ staff. Although the level of new accessions has dramatically diminished in recent years, with continued care the existing collection will remain serviceable well into the MCZ's second century and beyond. The collection also furnished the inspiration and much of the source material for the second major legacy of the MCZ Bird Department: James L. Peters' *Check-list of the Birds of the World*, an incomparable reference work completed by Peters' successors at the MCZ and cherished by all who do ornithological research.

Although the kind of collecting and research pursued at the MCZ has suffered from declining status since the end of the nineteenth century, there is evidence that a new renaissance may be on the horizon. The application of powerful new techniques from molecular biology to problems of classification might bring more rigor and excitement to this generally study-skin-bound field. In addition, as more and more species face the threat of extinction, scientists, university administrators, and funding agencies are beginning to acknowledge the importance of inventorying the world's biodiversity before it is too late. Both of these developments provide the potential for an increased level of support for the MCZ, its Bird Department, and the practice of taxonomy more broadly. With careful nurturing, Agassiz's ambitious dream may yet become a reality.

ACKNOWLEDGMENTS

This paper could not have been completed without the generous aid of many people. William (Ted) Davis was persistent in insisting that I take on the project and continued to offer much-needed encouragement along the way. Raymond Paynter, Jr., the present Curator of Birds at the MCZ, furnished invaluable insight into past and current practices in his department. Walter Bock, Clark Elliott, Ernst Mayr, Robert O'Hara, Peter Stevens, and François Vuillemier provided useful suggestions for improving an early version of the paper. Dana Fisher and the rest of the staff at the MCZ Library have been consistently helpful in providing access to the rich historical collection under their charge. And although I came to many of the

same conclusions independently, the analysis in this paper closely parallels and is indebted to Mary Winsor's magisterial study of the MCZ, *Reading the Shape of Nature* (1991). I am grateful to all.

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4

Ornithology at the University of Kansas[1]

Richard F. Johnston[2]

ABSTRACT.—Academic ornithology at The University of Kansas (KU) began 127 years ago, with the beginning of the University in 1866. Francis H. Snow, later Chancellor of the University, began the KU bird collection at that time, and pursued distributional and taxonomic studies on birds over the following 40 years. He was followed by Lewis L. Dyche, active in the period 1881-1909, and Charles D. Bunker, active from 1895 to 1942. Graduate studies were initiated in 1944 by E. Raymond Hall, and continue to the present time as a mutualistic program of the Department of Systematics and Ecology and the Museum of Natural History.

Over the years ornithology at KU has contributed to the development of vertebrate skeletonizing techniques; to the formation of the State bird organization, the Kansas Ornithological Society; to the incorporation of multivariate morphometrics into systematic and ecologic ornithology; to the use of electronic data storage and retrieval of museum specimen data; and to the enhancement of the processes involved in editing scientific journals. Since 1950, thirty-five doctoral degrees having ornithological dissertations have been awarded at KU.

The center of ornithology at the University of Kansas (KU) is the Museum of Natural History. The building housing the Museum, Dyche Hall (Fig. 1), is of eclectic, Romanesque architecture, with an entrance based on the Cathedral of St. Trophime at Arles, France. Dyche Hall's ornamentation includes six aedicules, two each on the south, east, and north walls. Names

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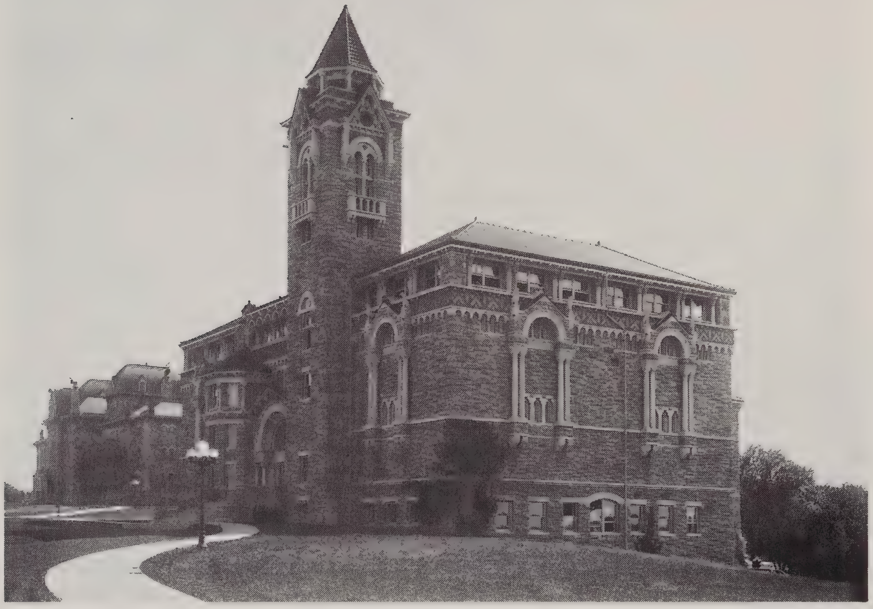

Fig. 1. Dyche Hall in 1905, not long after construction was completed. The north face of the building, shown here, was hidden by the addition of 1963.

of prominent naturalists are carved into the entablatures within the columns of the aedicules: the east (front) side, memorializes Charles Darwin and Thomas Henry Huxley, the north side John James Audubon and Asa Gray, and the south side Edward Drinker Cope and Louis Agassiz. This is a formidable sextet, the quality of which has set goals for Kansans at the museum for nearly 90 years, although the history of vertebrate biology and ornithology at KU is older than this suggests.

IN THE BEGINNING: 1866–1882

The inception of ornithology as an academic discipline at the University of Kansas has roots reaching beyond the middle of the 19th century, but the formal date identified is 14 September 1866 when the charter of the University went into effect (Hyder 1953). The first Professor of Natural History, later Chancellor of the University, was Francis H. Snow (Fig. 2). Snow, who was broadly trained and had strong interests in ento-

Fig. 2. Francis Huntington Snow, about 1895.

mology and ornithology (Dyche 1909), spent the day either of the official opening of the University (Hyder 1953), or two days prior to it (Griffin 1974), in the field taking zoological specimens, including birds. Snow was important in establishing a Cabinet of Natural History, administered by the Department of Natural History, and it was in fact a glass-fronted display cabinet housed in North College that contained the mounted bird specimens that were the first evidence of a bird collection at KU.

Snow continued collecting birds and contributed distributional notes and summary lists of the birds of Kansas to the periodical literature beginning in 1872, at which time 239 species and varieties were known from the State. By 1903, his list, the fifth, included 305 species, suggesting that field work on birds in the intervening 33 years had been reasonably vigorous (Snow 1903). The need for an assistant to help with teaching and the vertebrate collections, which by then included more than birds, was evident by the early 1880s. Lewis Lindsay Dyche was hired to assist Snow in 1881 and became Assistant Professor of Natural History in 1884. Snow was thus enabled to spend time looking after the funding and construction of (old) Snow Hall, which was completed in 1886.

THE TURN OF THE CENTURY: 1886-1910

L. L. Dyche (Fig. 3) was a charismatic and dominant personality, and one of the persons leading KU to a high level of accomplishment in natural history and ultimately to national recognition. Dyche's forte was expeditionary field work and natural history displays, with taxidermic mounts in naturalistic settings. He was uncommonly successful in obtaining national publicity as well as significant local funding for his work. In 1901 the Museum of Natural History, soon to be called Dyche Hall, was begun (Fig. 4), in no small measure in order to house Dyche's panorama of North American Mammals that had attracted worldwide attention when exhibited at the World's Columbian Exposition at Chicago in 1893. The museum building has been occupied by museum business ever since.

The importance of Dyche to the early development of vertebrate biology at Kansas cannot be exaggerated. In spite of his entrepreneurship, he successfully established the idea of a natural history museum as a functional part of the University of Kansas, showing how natural history display could be a significant educational, as well as fund-raising, tool (Sharp and Sullivan 1990). Dyche's major phyletic fealty was to mammals, and although he did collect birds and contribute to the avian distributional literature, his chief contribution to ornithology was in enriching the environment in which it could thrive at Kansas.

THE EARLY 20TH-CENTURY: 1910-1944

Dyche had added the position of State Fish and Game Warden to his responsibilities in 1909, and his museum duties were gradually assumed by Charles Dean Bunker (Fig. 5), who had become an assistant at the Museum

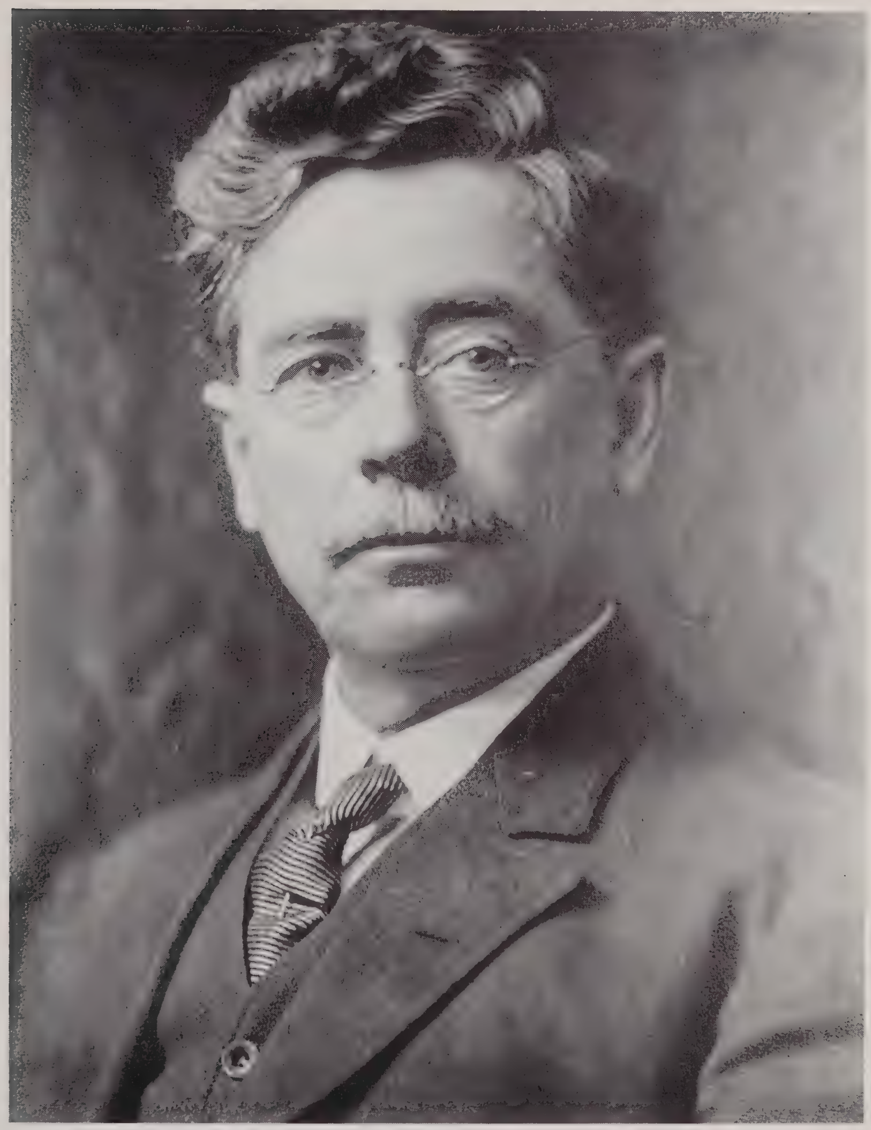

Fig. 3. Lewis Lindsay Dyche, about 1910.

in 1895. Bunker created the first complete catalog of the museum collections, sometimes getting data by word-of-mouth from Dyche (Hall 1951). He became Assistant Curator of Birds and Mammals in 1907, and Assistant Curator in Charge in 1909, when Dyche was named State Warden. Bunker

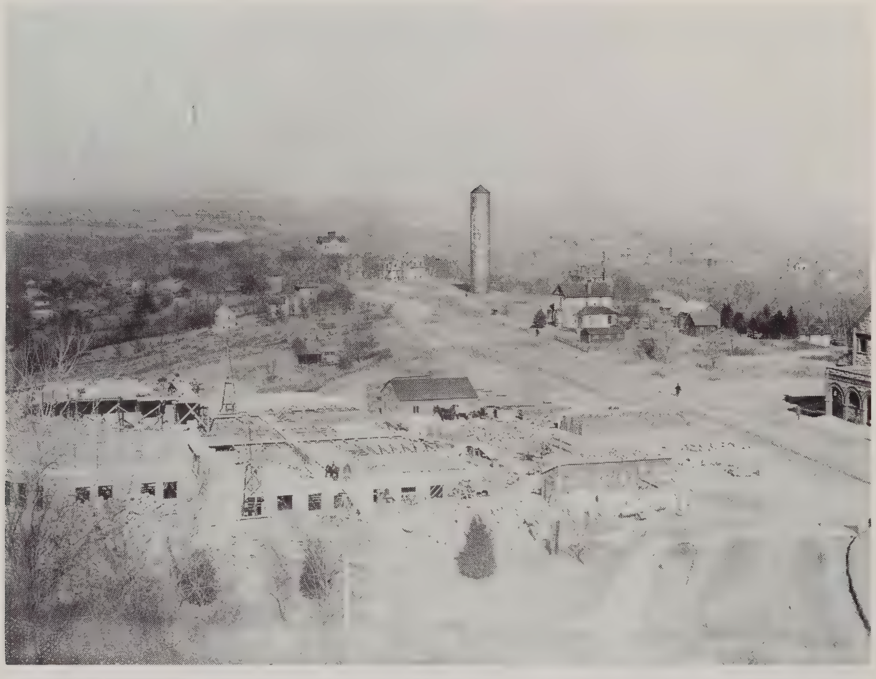

Fig. 4. View of The Hill looking north from old Fraser Hall in 1901. Construction of Dyche Hall is underway (foreground); a corner of Spooner Hall, then the University Library, appears at the far right; North Hall is evident on the edge of the hill, left middleground.

emphasized specimens as research and teaching resources rather than items for display. He also continued the tradition of expeditionary field work in collecting vertebrates, specialized in birds, and concentrated on the preparation of whole skeletons. He developed innovative techniques for cleaning bones, emphasizing methods for the maintenance of colonies of dermestid beetles, the larvae of which were already known for their ability to clean bones precisely and without damage. Under Bunker's guidance, the ornithological skeleton collection at KU had achieved national recognition by the 1930s. Bunker's view of the Museum as a generator of new knowledge, a center for research rather than one primarily for passive display, was one of his important insights.

Students, 1915–1944.—Bunker also was an extremely effective teacher in the setting of a research museum, and his record of undergraduate instruction is hard to match. Alexander Wetmore was an undergraduate at KU and worked in the bird collections under Bunker. Wetmore later

Fig. 5. Charles Dean Bunker, about 1923.

completed postgraduate degrees at Washington University, developed into one of the leading ornithologists of all time, and eventually became Secretary of the Smithsonian Institution. Another future Smithsonian scientist (ultimately Assistant Secretary for Science) was Remington Kellogg, also a student with Bunker, specializing in mammalogy. Other Bunker undergraduates achieving high status in ornithology were Jean M. Linsdale, later of the Museum of Vertebrate Zoology (MVZ) at Berkeley and Hastings Natural History Reservation, and William H. Burt, also of MVZ and the University of Michigan Museum of Zoology. E. Raymond Hall was one of "Bunk's Boys" also going on to MVZ, ultimately returning to KU to lead the Museum of Natural History to international prominence. Claude Hibbard and Ruben Stirton also studied with Bunker and went on to fame as mammalian paleontologists, the former at Michigan and the latter at Berkeley, withall preserving the broad orientation to vertebrate biology they learned at Kansas with Bunker. Bunker retired in 1942.

MID-CENTURY DEVELOPMENT: 1944-1967

The return of E. R. Hall to his native Kansas in 1944 was a promise that the development of vertebrate biology and the Museum of Natural History was to continue and expand. The record is clear on this—Hall instituted a graduate program that was almost immediately successful, and in relatively short order secured faculty curators for all the vertebrate groups represented in the Museum. He was able to do this so readily partly because of the power accruing from his being appointed Chair of the Department of Zoology as well as Director of the Museum. The museum was successful due to Hall's use of the Berkeley model—most curators were secured after national searches and they were cross-appointed in the Museum and the Department of Zoology (later to become Systematics and Ecology) on 12-month contracts—and to a strict and disciplinarian single-mindedness about museum protocols.

Donald S. Farner was the first ornithologist to join the faculty of the Department of Zoology, staying for the year 1946-47. It was not until 1948 that the Division of Ornithology at the Museum got its first curator, Charles G. Sibley, who left in 1949 for San Jose State College. Harrison B. Tordoff joined the Department and the Museum in 1951 and initiated the first functionally independent graduate program in ornithology at KU. Tordoff left for Michigan in 1957 and was replaced by Richard F. Johnston. In 1965 Robert M. Mengel joined the Department of Zoology. At Hall's retirement in 1967, Philip S. Humphrey became Director of the Museum, Chair of the Department, and the third ornithologist on the staff.

In addition to those noted above, other members of the Department occasionally provided graduate instruction for students in ornithology: A. Byron Leonard, Henry S. Fitch, Rollin H. Baker, and Theodore Eaton.

In keeping with Hall's interest in establishing a high level of museum studies in systematic biology, most of the curators he secured trace their academic lineages to Louis Agassiz, founder of the dominant North American academic museum tradition, whose own lineage included Georges Cuvier (1769–1832) and Lorenz Oken (1779–1851). One modern KU lineage includes Tordoff, Humphrey, and Mengel, all of whom studied with Josselyn Van Tyne at Michigan. Van Tyne worked with Alexander Ruthven (Michigan), who studied with C. C. Adams (Michigan), who took his degree with C. O. Whitman (Chicago), who did his work with Agassiz at Harvard. A second lineage from Agassiz led through David Starr Jordan (Stanford) to Joseph Grinnell (California, Berkeley). Grinnell was major professor to Burt, Fitch, Hall (who was major professor to Baker at KU), and Alden Miller, who in turn fostered Eaton, Sibley, and Johnston. Thus, ten of the 12 graduate instructors listed above came from a single academic museum lineage in North America. Earlier, in the summer of 1874, F. H. Snow studied at the Penikese Island Biological Station under Alexander Agassiz, who had studied under his father.

Students, 1944–1966.—It was not until E. R. Hall headed up vertebrate biology that the modern era of graduate studies began at Kansas. Hall's interests were predominantly in North American mammalogy, but he nevertheless directed the graduate work of a number of young ornithologists. His students of the late 1940s included M. Dale Arvey (phylogeny of waxwings), Rollin H. Baker (avifauna of Micronesia), George H. Lowery (nocturnal migration), and William B. Stallcup (myology and serology of the Fringillidae). At a slightly later time A. B. Leonard was major professor to E. Bruce Holmes (hindlimb muscles and nerves of grouse). Rollin Baker chaired the committee for Maurice F. Baker (ecology of prairie chickens), and Henry Fitch directed the work of Dwight Platt (biology of the American Crow, *Corvus brachyrhynchos*) and George Boone (ecology of the Red-bellied Woodpecker, *Melanerpes carolinus*). Harrison Tordoff directed Thane Robinson (ecology of the Northern Bobwhite, *Colinus virginianus*) and Glen Woolfenden (breeding biology of *Ammospiza* spp.). Theodore Eaton was major professor for Marion A. Jenkinson (variation in arteries of swallows and pigeons). Richard Johnston chaired committees of Jon Barlow (biology of Bell's Vireo, *Vireo bellii*), Abbott Gaunt (fossorial adaptations in the Bank Swallow, *Riparia riparia*), J. W. Hardy, who began with Tordoff (behavior of New World jays), Erwin E. Klaas (*Clinostomum marginatum* in the Great Blue Heron, *Ardea herodias*), Robert Merz (myology of pigeons), John Newman (behavior of the American Tree Sparrow, *Spizella arborea*), Max Thompson (birds of North Borneo), Emil Urban, who began with Tordoff (birds from Coahuila, Mexico), and Joyce Wildenthal (vocalizations of the Northern Mockingbird, *Mimus polyglottos*).

High points in this period include the completion of a large addition on the north side of the Museum, which hid the aedicules memorializing Audubon and Gray, but which allowed significant expansion of all research divisions; ornithology was able to expand by about 80% in square footage for specimens and office space. In 1964, the 82nd Stated Meeting of the American Ornithologists' Union was held at KU, with the Local Committee chaired by Johnston.

THE RECENT PERIOD: 1967-1990s

The significant steps taken in earlier years toward making ornithology an international discipline at Kansas were continued and expanded following the appointment of P. S. Humphrey to the directorship of the Museum and Chair of the Department. Humphrey was working on biodiversity of lowland Amazonian bird communities and on the distribution and abundance of seabirds in the tropical Pacific Basin. Johnston studied House Sparrows (*Passer domesticus*) and feral pigeons (*Columba livia*), which included field work in Europe and South America as well as North America. Additions to the staff in this period included R. M. Mengel, who took over from Johnston in 1968 when the latter was on a leave of absence as Program Director For Systematic Biology at the National Science Foundation (NSF). Mengel held his position until 1989, when he retired from academic life. He was replaced by Richard Prum, whose research is in Latin America, in 1991. Larry Martin joined the staff in 1972 and has been responsible for the program in avian paleontology. Johnston retired in 1992, and was replaced by Townsend Peterson, working on Central American birds, in 1993.

Young postdoctoral researchers first appeared in this period. Douglas Siegel-Causey (1983–1993) worked with P. S. Humphrey on NSF-funded biogeography and systematics of seabirds of southern South America, assembled the first molecular systematics laboratory in the Museum, pursued independent research projects, notably on cormorant phylogeny and arctic biodiversity, and participated in departmental instruction. Bradley Livezey (1985-1993) finished studies on phylogeny of the Anatidae and undertook NSF-funded work on flightlessness in birds. Pamela Rasmussen (1990–1991) continued studies on blue-eyed shags and David Seibel (1991–1992) worked on phylogeny of the cuculiform birds.

Students, 1966–1991.—Robert Mengel was chair of the committees of Robert Fleet (ecology of the Red-tailed Tropicbird, *Phaethon rubricauda*), James Parker (ecology of the Mississippi Kite, *Ictinia mississippiensis*), and Sievert Rohwer (molt and breeding schedules of the Chuck-will's-widow, *Caprimulgus carolinensis*). Philip S. Humphrey directed A. B. Amerson (avian ecology of the northwestern Hawaiian Islands), Bradley Livezey (systematics and flightlessness of steamer-ducks), Yoshika Oniki (ecology of ant-following birds in Brazil), Pamela Rasmussen (systematics of blue-eyed shags), and David Seibel (phylogenetic systematics of the Cuculidae). Richard Johnston chaired committees of Rosetta Arrigo (ecology of parkland birds in St. Louis), Timothy Broschat (morphological phenetics of motmots), John Bucher (ecomorphology of shorebirds), Brent

Burt (ecology of the Scrub Jay, *Aphelocoma coerulescens*, in Texas), Calvin Cink (behavior of the House Sparrow), Jeffrey Cox (ecology of overwintering hawks), Tristan Davis (phylogenetics of *Columba*), Robert Fleischer (population genetics of the House Sparrow), Andrew Finfrock (ecology of overwintering hawks), Suzanne Hamilton (ecomorphology of the House Sparrow), Pamela Heater (ecology of woodland birds), Jerome Jackson (geographic size variation in the Hairy Woodpecker, *Picoides villosus*), Steven Johnson (population biology of the feral pigeon), William Klitz (allozyme variation in the House Sparrow), Peter Lowther, Bruce McGillivray, and Edward Murphy (population biology of the House Sparrow), Michael Murphy (population biology of the Eastern Kingbird, *Tyrannus tyrannus*), David Niles (geographic variation of the Horned Lark, *Eremophila alpestris*), Christopher Norment (biology of high-latitude *Zonotrichia*), Gary Packard (geographic variation in the House Sparrow), John Paul (morphologic variation in island populations of the House Sparrow), Galen Pittman (biology of seabirds), Dennis Power (geographic variation in the Red-winged Blackbird, *Agelaius phoeniceus*), James Rakestraw (community ecology of woodland birds), Jose Rodriguez (size variation in the House Sparrow), James Rising (geographic variation and hybridization in the Northern Oriole, *Icterus galbula*), Sievert Rohwer (geographic variation and hybridization in Great Plains meadowlarks), Gary Schnell (phenetics of gulls), and Gary Worthen (ecology of woodland birds). Larry Martin and Robert Mengel chaired the committee of Robert Chandler (phylogeny of the Alcidae).

High points of the period include the computerization of the cataloged specimens of birds. The 102nd Stated Meeting of the American Ornithologists' Union was held at KU in 1984, with the Local Committee chaired by Marion A. Jenkinson. A group photograph taken at that meeting (Fig.6), includes the likenesses of 40 persons associated with the recent era in ornithology at KU.

Appendix I provides a list of the persons who have taken doctoral degrees in ornithology at KU. The professional contributions of a number of former KU students have been recognized by election to Fellowship or membership in the American Ornithologists' Union, and these are noted in the list.

PROGRAMS AND EVENTS OF HISTORIC SIGNIFICANCE

The Skeleton Collection.—The bird skeleton collection at KU is of more than passing interest. It numbers about 25,000 specimens, placing it among the three largest collections in the world. It was given its impetus

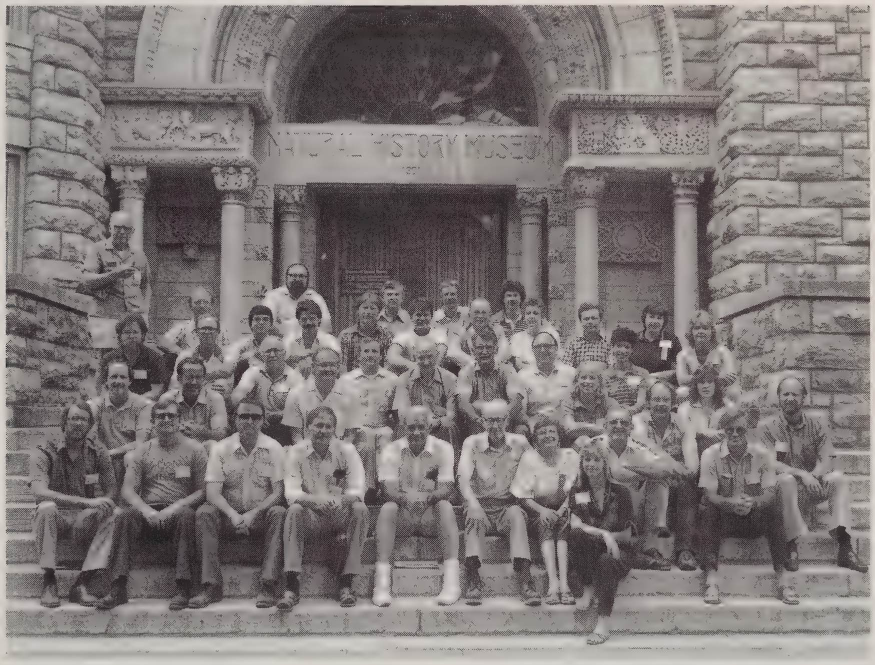

Fig. 6. An assembly of persons associated with ornithology at KU in the last half of the 20th-Century as they appeared on the steps of Dyche Hall in August 1984, at the 102nd meeting of the American Ornithologists' Union. Back row: Donald S. Farner; Peter E. Lowther; Larry D. Martin; John E. Bucher; J. D. Stewart; Lawrence M. Witmer; third row: John T. Paul, Jr.; Norman L. Ford; David E. Seibel; Michael T. Murphy; Robert C. Fleischer; Mark Holmgren; Philip S. Humphrey; Sandra L. L. Gaunt; Abbot S. Gaunt; Pennie von Achen; second row: Jeffery T. Cox; Edward C. Murphy; Erwin E. Klaas; Glen E. Woolfenden; James D. Rising; Charles G. Sibley; Robert W. Dickerman; Gary D. Schnell; Christie L. Wilkerson; Rosetta Arrigo; Douglas Siegel-Causey; Danielle Morlock; Pamela Rasmussen; Dennis M. Power; front row: Calvin L. Cink; Jerome A. Jackson; Jon C. Barlow; Clayton White; Harrison B. Tordoff; Robert M. Mengel; Marion A. Jenkinson; Sandra Herrington; Max C. Thompson; Richard F. Johnston.

by C. D. Bunker, and many of the unusually long series of specimens were assembled in his time. This preferential attention continues to the present. Noteworthy series of specimens are available for mid-American species, South American seabirds, feral and wild Rock Doves, Horned Larks, meadowlarks, and House Sparrows. Provenance is world-wide, with good representation from Australia, North Borneo, and Mexico.

Phenetics and Multivariate Morphometrics.—Developments in numerical phenetics by Robert Sokal, James Rohlf, and Charles Michener of the Department of Entomology at KU led to a number of discrete lines of research. At KU, the discipline of numerical taxonomy flourished in entomology and was pursued by a few graduate students in ornithology. There was great response to the multivariate statistical methods that Sokal and his colleagues employed, use of which became possible because of developments in digital computers in the 1950s and 1960s. Graduate students in ornithology began using multivariate statistics in the mid 1960s (thus forcing their professor also to use them), and notable dissertations with early use of these statistical methods were completed by Dennis Power, Jerome Jackson, Sievert Rohwer, James Rising, and David Niles. Johnston's project with Robert Selander on size and color variation and evolution in populations of House Sparrows introduced into North and South America had just begun, and although their early papers on sparrows used conventional univariate statistics, later ones also employed multivariate work. The series of House Sparrow papers was recognized for the innovative use of multivariate morphometrics by the Coues Award for 1975 from the American Ornithologists' Union. Today, studies on evolutionary trends in size and shape, such as Livezey's on multivariate morphometrics of flightlessness, are considerably more sophisticated than those done on House Sparrows. These are now mediated by terminal-access mainframe and PC multivariate statistical packages of enormous flexibility, whereby an analysis that might have required three months in 1969 is completed in part of an afternoon.

The Kansas Ornithological Society.—When Charles Sibley arrived at KU in 1948, he was surprised to find no ornithological organization for the State of Kansas. Through Sibley's efforts, and with the cooperation of concerned amateurs as well as E. R. Hall and the Museum, the organization of the Kansas Ornithological Society was realized. The Society had its first meeting in May 1949 at the Museum of Natural History, and has since gone on to be one of the most successful of State ornithological and conservation-oriented societies.

Scientific Editorships.—A number of scientific journals have been edited by members of the Division of Ornithology. The first was the *Wilson Bulletin*, edited by H. B. Tordoff from 1951 to 1954. This was a landmark event for the Division, for the Museum, and for the city of Lawrence, as it signalled the conversion of The Allen Press from an unknown small-town press to an internationally-recognized printer of scientific journals. Perhaps more importantly, it marked the re-emergence of ornithology at the Museum of Natural History, which had become known mainly as a center of mammalogy.

Tordoff had wanted to do the *Wilson Bulletin* with as little fuss and bother as possible. So, he insisted that the journal be printed in Lawrence, at The Allen Press; this, he assumed would make his job as comfortable as any editorship could be. Harold Allen, founder of the press, and his son Arly were apparently preadapted to doing scholarly and scientific journals, did the *Wilson Bulletin* in fine fashion, and ultimately became the most visible of North American scientific and scholarly publishers. The *Wilson Bulletin* is still printed at The Allen Press, as is *The Auk*, *The Condor*, *The Journal of Field Ornithology*, and *The Ibis.*

The Auk was edited by R. M. Mengel from 1962 to 1967, and he also edited *Ornithological Monographs* in 1972–1973. R. F. Johnston was the founding editor of *Current Ornithology*, and edited the first five volumes, from 1981 to 1988.

The *Bulletin of the Kansas Ornithological Society* was edited by Tordoff in 1956–1957, by J. W. Hardy in 1957–1959, and by Johnston from 1959–1969. In non-ornithological efforts, Johnston also edited *Systematic Zoology* from 1967–1970 and *Annual Review of Ecology and Systematics* from 1968–1992.

Because of the pervasive editorial activity in the Division of Ornithology, graduate students there had the opportunity to get experience at many of the routines involved in editing scientific publications. The following former students in the Division have later edited national-level scientific journals: Jerome Jackson, *Wilson Bulletin*, 4 volumes, 1975-1978; *Journal of Field Ornithology*, 5 volumes plus 1 number, 1980-1985; *North American Bird Bander*, 2 volumes, 1981, 1982; Jon Barlow, *Wilson Bulletin*, 6 volumes, 1979–1984; Dennis Power, *Current Ornithology*, 7 volumes, 1989–1994; Gary Schnell, *Systematic Zoology*, 3 volumes, 1984–1986, and *The Auk*, 1991–present; J. W. Hardy, *Ornithological Monographs*, nos. 13–26, 1972–1978. A number of other former students have had editorial posts with in-house publications at museums and universities.

Electronic Data Storage and Retrieval.—In the 1980s, Marion A. Jenkinson, holding an adjunct curatorship in the Division, set out to create a computer-based catalog file, wherein each specimen would be represented by electronic file space in which all information concerning the specimen was stored. The file could be addressed by combinations of desired data, so that, for example, all data for a given species on male specimens with testes larger than 7mm from NW Oklahoma taken between May 1 and June 30 could be retrieved. Except for House Sparrows, the file was completed at the end of 1985, with the aid of an NSF–BRRP collections assistance grant. I note that the classical paper catalog is still intact and functional.

Jenkinson later expanded the electronic facility to regional status, and it now accesses records from 12 additional museums: Walla Walla College, Walla Walla, Washington; University of Nebraska, Lincoln, Nebraska; Kearny State College, Kearny, Nebraska; Wayne State College, Wayne, Nebraska; Iowa State University, Ames, Iowa; Fort Hays State University, Hays, Kansas; Emporia State University, Emporia, Kansas; Southwestern College, Winfield, Kansas; Gaylord Memorial Lab, University of Missouri, Puxico, Missouri; Cooperative Wildlife Unit, University of Missouri, Columbia, Missouri; Stovall Museum; University of Oklahoma, Norman, Oklahoma; and University of Arkansas, Fayetteville, Arkansas. Upgrading of equipment in 1993 allowed transfer of the catalog files from the KU mainframe to hard disks in desktop computers, mediated by new user-friendly software.

THE COLLECTIONS AS OF 1991

The catalog contains 85,679 entries. This is based on about 55,000 skin specimens, 25,000 skeletons, 4000 spirit specimens, and 1000 eggshell sets. Acquisition of specimens proceeds mostly along lines of research activity, but special collections are purchased as funds allow.

This brief history has stressed the contributions to ornithology made by members of the Museum of Natural History and the Department of Systematics and Ecology. Other components of KU have nevertheless been a part of study and instruction in avian biology. The Kansas Biological Survey has supported graduate research in ornithology since the 1940s, and a number of degree programs have received substantial benefit from such funding. The Kansas Ecological Reserves (KER) administers University-held tracts of land in eastern Kansas. These range from uncut woodland and unmowed prairie through secondary successional tracts to disturbed agricultural land, and all are or have been used in a variety of studies on avian autecological and prairie and woodland community research. The jewel in the crown of these field reserves is the Fitch Natural History Reservation, six miles northeast of KU, which, under the guidance of Henry Fitch, has been the focus of field ecological research since the 1940s; many of the studies were on birds.

ACKNOWLEDGMENTS

Philip S. Humphrey, Kathy Dwigans, and Jerome A. Jackson read and commented on late drafts of the manuscript, correcting some errors of fact. Photographic negatives from which figures 1-5 were printed are on file in the Archives of the University of Kansas; Marion A. Jenkinson supplied the negative for Figure 6.

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APPENDIX I

Ornithological Doctorates at KU, 1950–1992.

Arvey, M. Dale, 1950; formerly Chair, Department of Biology, University of North Carolina, Charlotte. Fellow, AOU. Deceased.

Baker, Maurice F., 1952.

Baker, Rollin H., 1950. Elective Member, AOU.

Barlow, Jon C., 1964. Professor of Zoology and Curator of Birds, University of Toronto and Royal Ontario Museum, Toronto, Ontario. Fellow, AOU. President, Wilson Ornithological Society, 1989–1991.

Bucher, John, 1984. Director, Computation Center, Kansas State University, Manhattan.

Chandler, Robert, 1991. Collections manager, Florida State Museum, University of Florida.

Cink, Calvin, 1974. Professor of Biology, Baker University, Baldwin, Kansas.

Fleischer, Robert, 1983. Director, Molecular Systematics Laboratory, National Zoological Park, Washington, DC. Elective Member, AOU.

Gaunt, Abbot S., 1963. Professor of Zoology, Ohio State University. Fellow, AOU. President, Wilson Ornithological Society, 1981–1983.

Hardy, John William, 1959. Professor of Zoology and Curator of Birds, University of Florida and Florida State Museum. Fellow, AOU.

Holmes, E. Bruce, 1962. Professor of Biology, Northern Illinois University at Macomb.

Jackson, Jerome A., 1970. Professor of Biological Sciences, Mississippi State University. Fellow, AOU. President, Wilson Ornithological Society, 1983–1985.

Johnson, Steven, 1990. Postdoctoral research, University of Indiana, Bloomington .

Klaas, Erwin E., 1970. Professor of Biology, Iowa State University. Elective Member, AOU.

Klitz, William, 1972. Department of Integrative Biology, University of California, Berkeley.

Livezey, Bradley, 1985. Associate Curator of Birds, Carnegie Museum, Pittsburgh, PA. Elective Member, AOU.

Lowery, George, 1950. Professor of Zoology and Director, Museum of Zoology, Louisiana State University. Fellow, AOU. President, American Ornithologists' Union, 1960–61. Deceased.

Lowther, Peter, 1977. Research statistician, Field Museum of Natural History, Chicago. Elective Member, AOU.

McGillivray, Bruce, 1981. Curator of Birds, Alberta Provincial Museum, Edmonton. Elective Member, AOU.

Murphy, Edward, 1977. Professor of Biology, University of Alaska, Fairbanks. Elective Member, AOU.

Murphy, Michael, 1984. Professor of Biology, Hartwick College at Oneata, New York.

Niles, David, 1972. Wilmington, Delaware.

Norment, Christopher J. 1992. Assistant Professor of Biology, State University of New York College at Brockport, Brockport, New York.

Packard, Gary, 1966. Professor of Zoology, Colorado State University.

Parker, James, 1972. Eastern Environmental Programs, Farmington, Maine.

Platt, Dwight, 1969. Professor of Biology, Bethel College, Newton, Kansas.

Power, Dennis, 1967. Director, Oakland Museum of Natural History, Oakland, California. Fellow, AOU.

Rakestraw, James, 1981. Atlanta, Georgia.

Rasmussen, Pamela, 1990. Research Associate, National Museum of Natural History, Washington, D.C..

Rising, James, 1968. Professor of Zoology, University of Toronto. Fellow, AOU.

Robinson, Thane, 1956. Professor of Biology, University of Louisville. Deceased.

Rohwer, Sievert, 1973. Professor of Zoology, Curator, Burke Museum of Natural History, University of Washington. Fellow, AOU.

Schnell, Gary, 1969. Professor of Zoology, University of Oklahoma; Director, Oklahoma State Biological Survey; Curator of Birds, Stovall Museum. Fellow, AOU.

Seibel, David, 1989. Postdoctoral researcher, Museum of Natural History, University of Kansas.

Stallcup, William B., 1954. Professor of Biology, Southern Methodist University.

Worthen, Gary, 1977. Midvale, Utah.

5

Ornithology at the American Museum of Natural History

Wesley E. Lanyon[1]

Abstract.—A review of the 105-year (1885–1990) history of ornithology at the American Museum of Natural History in New York reveals this institution's profound impact on the development of ornithology in North America and its position as a cross-roads and gathering place for ornithologists around the world. Its large and diverse research collections constitute a vital national and international resource that provides material for hundreds of scientists and visitors annually. Through the years ornithologists on its staff have amassed a distinguished record in research and education in the evolution, systematics, biogeography, and conservation of the birds of the world. No other group of ornithologists has played a bigger role in serving the American Ornithologists' Union or has received more recognition and honors from that organization.

The Department of Ornithology at the American Museum of Natural History in New York has had a long history of research and education in the evolution, systematics, biogeography, and conservation of the birds of the world. Its research collections, now numbering nearly a million specimens, are not only rich in numbers, but also diverse in taxonomic and geographic representation. They represent all of the avian families, all but 10 or fewer of the genera, and 99 percent of all species of birds. They include over 6300 type specimens, unique or rare specimens of great historic value, and large series from all continents, including some of the most remote places on Earth. This completeness becomes increasingly valuable with time as one species after another becomes extinct. The collections constitute a vital national and international resource that provides material for much of the research conducted by the Department's staff and for hundreds of scientists and other visitors annually. Each year several thousand specimens are loaned to qualified investigators at other museums around the world.

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The Department of Ornithology occupies one wing of the Museum, along Central Park West in New York City. This building consists of eight floors and includes offices, laboratories, space for collections, library, aviaries, public exhibition galleries, and an art gallery—one of the most commodious and best-equipped ornithological centers of learning in the world. As a result of its unique collections, library resources, financial resources for support of research, educational programs, and the expertise of its staff, it is not surprising that the Department maintains its position as a cross-roads and gathering place for ornithologists and would-be ornithologists. Although this influence has extended around the world, it had a particularly profound impact on the development of ornithology in North America. In this reconstruction of the history of the Department, I have made frequent use of the annual reports of the Department (1885–1990) in the archives of the American Museum of Natural History.

A DEPARTMENT IS BORN (1885–1920)

The American Museum, founded in 1869 and well on its way to becoming the largest natural history museum in the world and an important research institution, had no ornithologist on its staff prior to 1885. Mounted birds purchased in Paris had to be identified by Robert Ridgway of the Smithsonian. E. A. Mearns, H. B. Bailey, and A. K. Fisher worked as volunteers in cataloging specimens. This appears to be something of a contradiction, considering that the American Ornithologists' Union (AOU) was founded at the Museum in 1883 (Palmer 1933, Fig. 1). Perhaps New York was selected for this historic gathering because of its "neutral" location between the older museums and ornithological bastions in Boston, Philadelphia, and Washington. Joel A. Allen, then at the Museum of Comparative Zoology in Cambridge, was ill and unable to attend, but he was duly awarded the Union's first Presidency. In 1885 Allen was lured to New York to serve as Curator in the newly formed Department of Ornithology and Mammalogy, a base from which he served the AOU as President until 1890, as Editor of *The Auk* until 1911, and Editor of the first three editions of the *Check-list of North American Birds* (Coues et al. 1886, 1895, Allen et al. 1910). Until 1933 the Department was located on the fifth floor of the old north wing of the Museum. Allen worked diligently to build a research collection of birds and by 1887 had acquired about 39,000 specimens. His ultimate goal was explicit in his annual report of that year,

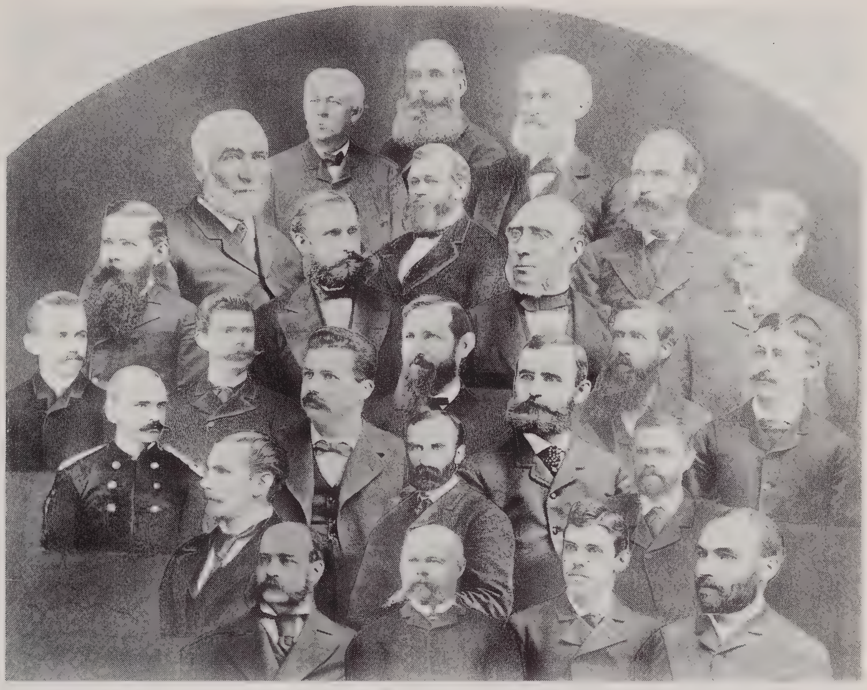

Fig. 1. On 1 August 1883, a letter signed by J. A. Allen, Elliott Coues, and William Brewster was sent to 48 leading ornithologists inviting them to attend a meeting for the purpose of founding an American counterpart to the British Ornithologists' Union. Those who responded to the call met in the library of the American Museum of Natural History in September 1883, elected themselves Founders, and the American Ornithologists' Union came into being. J. A. Allen's portrait is in the center of this collage.

" . . . an opportunity is open to the friends of the Museum to purchase, ready at hand, a collection which would not only admirably meet this deficiency [the department's inadequate holdings], but give the American Museum unquestionably the first place, as regards its ornithological department, among the museums of this country—a position it can never take while this defect remains."

The hiring of Frank M. Chapman as Allen's assistant in 1888, unquestionably was the keystone in the subsequent growth of the Department. As Chapman developed competence as explorer, systematist, biogeographer, educator, and conservationist, he molded, guided, and inspired his staff through the 54 years during which he served the Museum (Chapman 1933).

The collection grew rapidly and by the annual report of 1889 Allen was able to boast that the museum was already one of the leading resorts of specialists engaged in ornithological work. In the report for 1917 he wrote that the Jonathan Dwight collection (over 47,000 specimens) is by far the largest and most scientifically valuable collection of North American birds extant. The staff also grew, with the appointment of Waldron DeWitt Miller as Associate Curator in charge of North American ornithology, structural and systematic problems in 1910, and James P. Chapin as Assistant Curator in charge of Old World ornithology in 1916. Charles H. Rogers was associated with the Department until 1920 when he resigned to become Curator in the museum at Princeton University. Ludlow Griscom became Assistant Curator in charge of Middle American and local ornithology in 1917.

A frenzy of exploration and collecting was launched by Chapman soon after his arrival, with trips to Florida, Texas, the West Indies, Mexico, and Canada, and by some of the most illustrious collectors employed by any museum: Austin Paul Smith, W. W. Brown, and A. W. Anthony in Middle America; M. A. Carriker, Jr., George K. Cherrie, Rex R. Benson, various members of the Olalla family, Ernest G. Holt, Rollo H. Beck, H. and C. Watkins, Leo E. Miller, and Howarth S. Boyle in South America; W. B. Richardson in Middle and South America; and C. H. Townsend in Hawaii and California. Two young ornithologists started their careers on these early expeditions: Arthur A. Allen replaced Richardson in Nicaragua, and James Chapin interrupted his studies at Columbia University to accompany Herbert Lang to Africa. Chapin had worked for a year in the Exhibition Department at the Museum, at the age of 16. Also during this period, Colonel Theodore Roosevelt led a South American expedition, and a young ornithologist at the Brooklyn Institute of Arts and Sciences, Robert Cushman Murphy, led an expedition to South Georgia (Chapman 1922).

During this period of active exploration and collecting Chapman was promoted to Curator of Birds in 1908, served the AOU as President (1911–1913), and pursued another of his principal interests—reaching the public through the Museum's exhibition program. His display of the bird life of Cobb's Island, Virginia, in 1902, was the first application of the "habitat group" concept, and it and the series of other groups that followed set a new standard in bird exhibits in museums throughout the world. The groups were based on original field studies by ornithologist, artist, and preparator, and their success was due in large measure to the talents of such artists as Louis Agassiz Fuertes and R. Bruce Horsfall. Chapman's commitment to public education was also served by his founding of *Bird-Lore* in 1899 (later renamed *Audubon Magazine*) and editing it until 1934 when it was taken over by the Audubon Society, and the publication of his classic *Handbook of Birds of Eastern North America* (Chapman 1895) and five other popular books during the next 13 years.

Prominent among Chapman's professional contributions during this period was the publication of his monograph on the birds of Colombia (1917), based on nearly 16,000 specimens obtained in eight expeditions (1910–1915), and the appearance of a similar volume on the birds of Ecuador (1926), based on a study of more than 13,000 specimens as well as on months of personal exploration covering thousands of miles of difficult terrain. These volumes were to serve as models and standard references for much of the later work by other ornithologists on the origin, distribution, and systematics of the birds of the Andean region of South America, and were the first to express a modern point of view with reference to the evolutionary and zoogeographic relationships of the birds.

CHAPMAN AND THE "GOLDEN YEARS" (1920–1942)

In 1920, with the number of birds in the collections approaching 200,000, the Museum authorized a division of the Department of Mammalogy and Ornithology into two departments. Chapman was appointed the first Curator in the newly created Department of Ornithology, a position which he held until his retirement in 1942. J. A. Allen retained his curatorship in the Department of Mammalogy but died in 1921. During the next two decades, the young Department enjoyed a period of great ornithological talent in a staff of five research-oriented curators—a level it was never again able to attain for any extended period. This was also a period of unprecedented exploration and collecting, of movement into splendid new quarters, and of the historic accession of the single most important collection acquired by the Department. These were truly the "golden years."

Chapman, of course, was at the helm as "Curator-in-Chief." His staff in the 1920s consisted of Robert Cushman Murphy as Curator of Marine Birds, James Chapin as Associate Curator of Birds of the Eastern Hemisphere, Waldron DeWitt Miller as Associate Curator, and Ludlow Griscom as Assistant Curator.

Murphy had previously served as naturalist on the whaling brig "Daisy" during a year's cruise in the South Atlantic, co-sponsored by the American Museum and the Brooklyn Institute of Arts and Sciences. The experiences gained on this voyage led to a lifelong fascination with and study of sea birds. After his return, Murphy served on the staff of the Brooklyn Museum until 1921, when he joined Chapman's team. His studies of sea birds culminated in his two-volume work on oceanic birds

(Murphy 1936), a pioneer contribution to our understanding of the relation between sea birds and their environment.

Chapin's earlier field work in the Congo lasted over five years, surely one of the longest uninterrupted assignments in the history of museum expeditions, and yielded 6400 bird specimens. Chapin was appointed Assistant Curator in 1921 and subsequently returned to the Congo five times. In 1936 while working in the Congo Museum in Belgium, he discovered two misidentified mounted specimens that he later described as the Congo Peafowl (*Afropavo congensis*)—a bizarre but fascinating case of serendipity (Chapin 1937).

Waldron DeWitt Miller's association with the Department began as an assistant to Chapman, who had him work up the birds collected by Batty and Richardson in Middle America. Miller was selected to work with Alexander Wetmore in devising the scheme of classification followed in the 4th edition of the AOU *Check-List* (Stone et al. 1931). Although he authored a few systematic papers based on collections received from Mexico, Miller's greatest contribution to ornithology may be his unpublished notes and manuscripts based on details of morphology made from numerous dissections, often of birds received from the New York Zoological Park. He had a phenomenal memory and was a keen student of the biological and phylogenetic significance of such anatomical features as the arrangement of toes, and the development of the tongue, bill, and rectrices. He died in 1929 from injuries sustained in a motorcycle accident.

Ludlow Griscom, the first graduate student under Arthur A. Allen at Cornell University, joined the Department as Chapman's assistant in 1917. In that year he visited Nicaragua with Waldron DeWitt Miller to obtain first-hand experience that might enable the two of them to work up the large collection made for the Department by W. B. Richardson. Later expeditions took him to Panama and Yucatan. Griscom was appointed Assistant Curator in 1920 and soon became a living legend among the bird watchers in the New York region. As Roger Tory Peterson (1965) acknowledged, "It was he, perhaps more than anyone else, who bridged the gap between the collector of the old school and the modern field ornithologist with the binocular." Griscom's (1923) *Birds of the New York City Region* was for many years the standard local work of reference.

The concept of Research Associate was formalized to apply to research-oriented but non-salaried staff members. There were two of these during the 1920s, and both were to leave an indelible mark on ornithology in the Americas: Jonathan Dwight (an M.D.) and Elsie M. B. Reichenberger (later Naumburg). Dwight, 25 years old at the founding meeting of the American Ornithologists' Union in New York in 1883, was elected an Associate Member of the AOU, and began a connection that lasted for 45 years. He was an inveterate collector and soon amassed a large private collection of birds that was moved to the Museum in 1909. An interest in plumage changes often led him to collect birds in molt, and their study resulted in Dwight's (1900) classic monograph on the sequence of molts and plumages. He was appointed Research Associate in 1921 and thereafter appeared his monograph *The Gulls of the World* (1925). At the time of his death in 1929, his collection of 55,000 skins was left to the Department, the single most valuable bequest to that time. Elsie M. B. Reichenberger became a Research Assistant in 1921 and, as Mrs. Naumburg, a Research Associate in 1923. Under Chapman's guidance, she began working up collections from various expeditions. Her patronage made possible the extensive collecting of Emil Kaempfer in Brazil, which she followed up with such notable publications as *The Birds of Matto Grosso, Brazil* (1930). Her main contribution was to come later, however, as a memorial to her mentor, Frank M. Chapman.

Though the 1920s were a remarkable period in the history of the Department, the 1930s were years of even greater achievement and progress, in part due to new perspectives and talents introduced by three additions to the curatorial staff (Fig. 2). Chapman lured John T. Zimmer from the Field Museum of Natural History in Chicago to become Associate Curator of Birds of the Western Hemisphere and to research the vast neotropical collections being amassed by the Department. Zimmer at once launched an ambitious research program to examine the avifauna of Peru, thereby complementing Chapman's previous monographs for Colombia and Ecuador. His studies were to set a high standard in avian taxonomy and serve as an indispensible reference and foundation for subsequent workers in South America (1937–1955). In 1928 Ernst Mayr had been commissioned to collect in New Guinea. A year later he joined the Whitney South Sea Expedition, which led in turn to his invitation to come to New York as a visiting Research Associate in 1931. In 1932 Mayr was appointed an Associate Curator, thus starting a long and productive association with the Department. Charles E. O'Brien had been employed by Chapman for a number of years to assist his staff with various curatorial tasks. Although without academic credentials, the young assistant showed an uncommon talent for learning quickly and had a phenomenal memory, and the "Chief" had him appointed an Assistant Curator in 1935. During his more than 40 years of service to the Department, O'Brien developed an unparalleled knowledge of the collection that earned him a reputation among professional ornithologists around the world as **the** curator to whom to turn for information.

Two Research Associates were appointed in the 1930s. While Austin L. Rand was a graduate student at Cornell University he was given an opportunity to collect birds on an expedition to Madagascar, co-sponsored by the American Museum of Natural History, the Archbold family (young

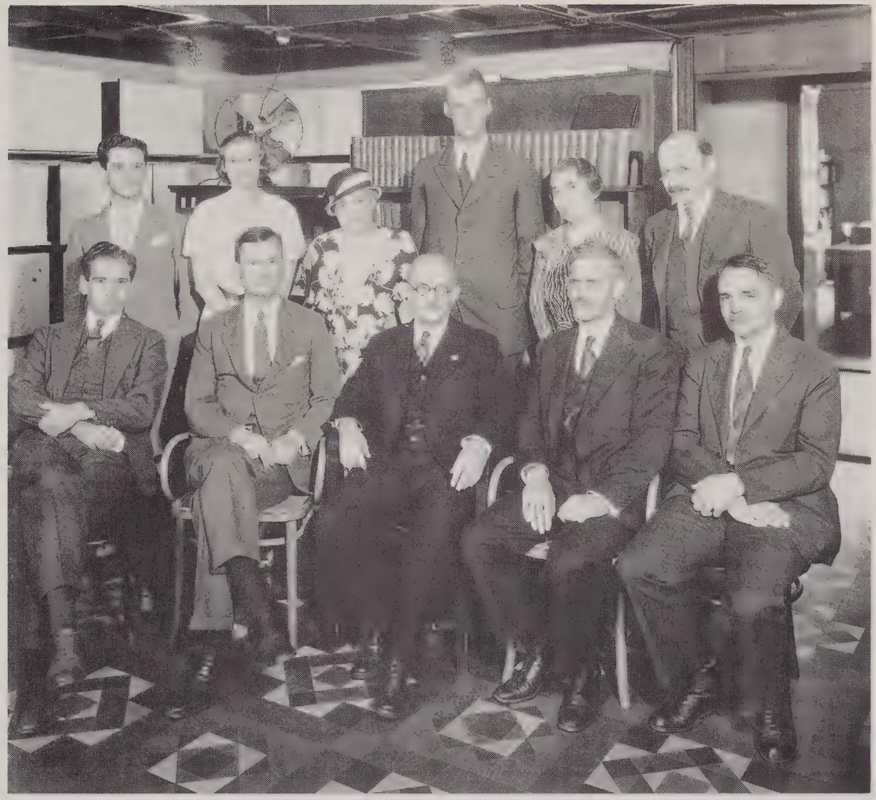

Fig. 2. Departmental photograph, taken on Frank Chapman's 70th birthday, 1934. Seated, left to right: (1) Ernst Mayr, Associate Curator; (2) Robert Cushman Murphy, Curator of Oceanic Birds; (3) Frank M. Chapman, Curator-in-Chief; (4) James P. Chapin, Associate Curator of Birds of the Eastern Hemisphere; (5) John T. Zimmer, Associate Curator of Birds of the Western Hemisphere. Standing, left to right: (1) Charles E. O'Brien, Research Assistant; (2) Kathryn Jones, Secretary; (3) Alice K. Frazer, Secretary; (4) Austin Rand, Research Assistant; (5) Elsie M. B. Naumburg, Research Associate; (6) Albert Brand, Research Associate.

Richard Archbold was a member of that expedition), and two European museums. Jean Delacour of the Paris Museum led the expedition, and one of the expedition members was James C. Greenway, Jr. These two ornithologists later were to have long associations with the Department in New York. Rand worked up the results of the expedition for his doctoral dissertation, later to be published by the Museum and become the standard reference on the birds of Madagascar (Rand 1936). Archbold sponsored three pre-war expeditions to New Guinea with Rand as ornithologist. The extensive collections were worked up by Rand, in some cases in collaboration with Mayr. Rand's association with the Department was formalized in 1937 with his appointment as Research Associate, a position he held until 1941. Also in 1937, Philip B. Philipp became a Research Associate in Oology, to curate the collection of eggs and nests. A young graduate of Hobart College, Dean Amadon, was hired as Philipp's assistant to help with integrating Philipp's personal collection of some 15,000 sets of eggs with the Department's collection.

Another reason for considering these the "golden years" of the Department is because of Leonard C. Sanford, a successful and gifted surgeon in New Haven and one of the grand patrons of ornithology. Sanford had been elected a Trustee of the American Museum of Natural History in 1921, a position which he held for nearly 30 years. A compelling interest in ornithology logically concentrated his efforts on behalf of the Department of Ornithology in the acquisition of specimens of rare and extinct species, and in the promotion of expeditions. He persuaded Frederick Brewster, also of New Haven, to finance the field work of Rollo H. Beck in the seas around South America that led to the collections used by Murphy in his classic two-volume work. But it was Sanford's influence with Harry Payne Whitney, eldest son of William C. Whitney, who had served President Cleveland as Secretary of the Navy and been a Trustee of the Museum (1891–1904), that put the Department on a more solid foundation. Mary LeCroy (1989), Senior Scientific Assistant in the Department today, related Sanford's next move:

> "The success of the South American expedition encouraged Sanford to consider a much more ambitious—and expensive—dream: a series of bird-collecting voyages throughout the South Pacific. He saw in the Pacific, a huge body of water dotted by thousands of islands difficult of access and scarcely known ornithologically, one of the last large expanses of the globe that would repay its exploration with new birds and expanded knowledge. But then World War I intervened.
>
> "After the war, the idea of a Pacific expedition was resurrected. In the words of [Robert Cushman] Murphy, 'No one to this day knows by exactly what steps Dr. Sanford lured his friend Harry Payne Whitney to take on such an expensive and prolonged undertaking. The original agreement was, I believe, limited to four years, but at the end of that period, the seductive tongue of Dr. Sanford continued to work effectively, and Mr. Whitney is reported to have said on one occasion to his friend 'Heff' Sage, 'Len's got me hogtied.' It is likely, of course, that Mr. Whitney was personally interested to a greater degree than he freely acknowledged'."

The Whitney South Sea Expedition, probably the most extensive series of ornithological collecting trips ever undertaken, was launched during the summer of 1920. The first field leader was the veteran explorer-naturalist, Rollo H. Beck, who already had behind him a long record of service to the American Museum. Later leaders were Hannibal Hamlin (1929–1931) and William C. Coultas (1931–1937). Whitney died in 1930, but his widow, Gertrude Vanderbilt Whitney, son Cornelius Vanderbilt Whitney, and daughter, Barbara Whitney Peck, generously maintained support of the expedition, which continued until World War II. With the advantage of possessing its own vessel, the expedition was able to work the Pacific archipelagos systematically. All the Polynesian groups with the exception of Hawaii, the Austral Islands, and New Zealand were investigated, and important collections were amassed in Melanesia and Micronesia as well—more than 3000 islands in all.

Henry Fairfield Osborn, then President of the Museum, wrote in his President's Report (1933): "The enormous growth of the Museum's bird collections, resulting from the Whitney South Sea Expedition, from work instituted in several parts of the Far East by Dr. Sanford, and from continuous South American field work, have long since turned our thoughts toward the need of a more adequate headquarters for the Department of Birds . . . The interest of Mr. Whitney had been continually whetted by the success of the work he had sponsored in the Pacific, and in January 1929, this led him to take steps leading toward the construction of a separate section of our building, to be devoted entirely to the science of ornithology."

Whitney contributed $750,000 toward the cost of a new wing of the Museum, conditioned upon the appropriation of a like amount by the City of New York. Osborn (1933) reported that it was the Administration's intent "to design and construct a building of an entirely unique order to embody all that the sixty-year experience of museum construction has taught us, and to look forward to an absolutely ideal center for further advancement of the historic science of ornithology." Ground was first broken for the Whitney Wing in 1931, and the bronze shovel used by President Osborn is a cherished item in the Department's archives. The wing was occupied in 1935, but it would be years before the exhibit galleries were completed.

During the construction of the Department's new headquarters, structural changes had to be made in the third floor due to still another superb gift from the Whitney family, the presentation to the American Museum of the Rothschild Collection of birds (Murphy 1932). President Osborn (1933) reported:

> "The famous museum at Tring, in Hertfordshire, dates only from the year 1889, and yet it long since attained the rank of one of the leading institutions of its kind. The development of so notable a

> museum during a single life-time is a great monument to the zeal and munificence of Lord Rothschild and to the wisdom with which he chose his collaborators. Of high importance among the treasures of Tring was the world-famous collection of birds . . . In October 1931, Lord Rothschild wrote Dr. Leonard C. Sanford saying that he had reluctantly determined to offer for sale the greater part of the Tring Collection of birds. Dr. Sanford then laid the unique opportunity before the members of the Whitney family, and there followed a rapid sequence of ornithological, legal, financial, and practical negotiations between Lord Rothschild, Dr. Sanford, Director George H. Sherwood, Curator Robert Cushman Murphy, and our Counsel . . . throughout which the interests of Mrs. Harry Payne Whitney and of her son and daughters were to be carefully guarded. At the end of January, 1932, Doctors Sanford and Murphy sailed for England. On February 13 . . . ownership of the great treasure was formally transferred . . . The extremely important work of cataloguing, packing, and shipping the collection was then begun at once under the direction of Dr. Murphy."

David Snow (1973) reported that Murphy made the following remarks in his journal of 1932, following the announcement of the sale of the collection at the annual dinner in London of the combined membership of the British Ornithologists' Union and the British Ornithologists' Club: "The occasion had not been without its dread for me, as I thought it over for many days in advance. So far as I could judge from what appeared on the surface, it ended in a love-feast rather than anything with a trace of bitterness. All credit for that, however, is due to the traits which make an Englishman the most mellow of God's creations!" Snow continued: "Lord Rothschild himself evidently weathered the immediate crisis remarkably well, considering what a permanent and shattering blow the loss of his collection was for him; and it is a fair guess that Dr. Murphy's handling of the transfer contributed much to this. No rancour appears in the brief but friendly note which Lord Rothschild sent him just before he left for New York with the last of the cases, and the typed catalogue—ending 'and thank you again for having made a rather thorny and thankless transaction pass off so smoothly'."

Unpacking, cataloging, and installing the huge Rothschild Collection (just under 280,000 specimens; Fig. 3), along with the simultanenous movement of collections and office equipment from the Department's old quarters into the new wing, was to occupy much of the staff's time during the late 1930s. Among the several young men hired to assist the curators in these tasks was E. Thomas Gilliard.

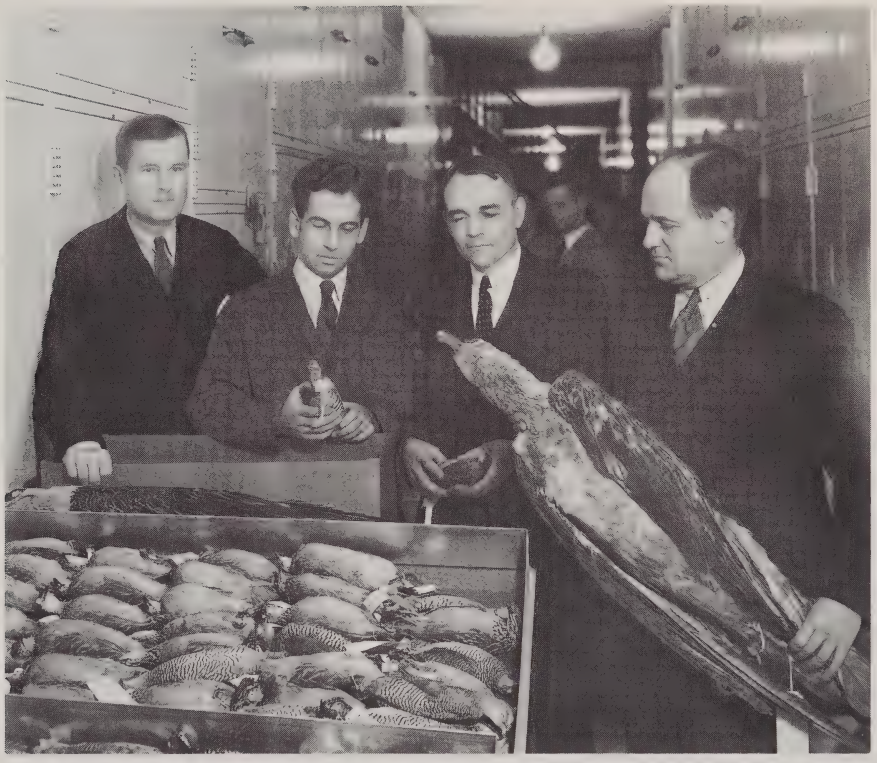

Fig. 3. Examining the newly arrived Rothschild Collection. Left to right: Robert Cushman Murphy, Ernst Mayr, John T. Zimmer, and President F. Trubee Davison.

The Whitney South Sea Expedition collected many of the specimens needed for the habitat groups that were to adorn one of the public halls, the Whitney Memorial Hall of Oceanic Birds, but a series of expeditions was sent to the South Pacific to make photographic records and detailed studies of the actual localities to be reproduced in the hall. One expedition member was Francis Lee Jaques of the Museum's Department of Preparation, who subsequently painted the dome, murals, and backgrounds for the hall. Although work would continue on them for years, exhibits were far enough along in the three public halls to permit them to be opened in 1939: the Whitney Memorial Hall of Oceanic Birds, the Hall of Biology of Birds (with its synoptic series of birds of the world and conceptual exhibits on avian biology), and the Audubon Gallery of Bird Art (with its historic collection of paintings by John James Audubon, Joseph Wolf, and Louis Agassiz Fuertes)—a fitting close of what truly were a remarkable two decades.

Testimony to the respect shown the members of the Department during these "golden years" are the honors bestowed upon them by their peers in the American Ornithologists' Union. Ten of the 12 holding research positions were elected Fellows of the AOU, and seven of these Fellows would serve the Union as President. Chapman, Murphy, Chapin, and Dwight served in that capacity during their careers in New York. Griscom left the Department for a position at the Museum of Comparative Zoology in Cambridge, Massachusetts; in 1957 he was elected President of the Union, but resigned almost immediately due to ill health. Mayr was his replacement as President, having earlier moved to Harvard University. Rand was to become President at a later date while holding the position of Chief Curator of Zoology at the Field Museum of Natural History in Chicago. Zimmer served the AOU as the fourth editor of *The Auk*, and as a member of the important Committee on Classification and Nomenclature. In addition, four of the eight curators were to receive the Brewster Award, given by the AOU for outstanding and meritorious publications on birds of the Western Hemisphere: Chapman, for his popular handbook, Murphy for his studies of oceanic birds, Zimmer for his collective contributions on the birds of South America, and Mayr (much later) for his "perceptive analyses of the history and zoogeography of the North American avifauna . . . [and] his influence upon the conceptual framework of avian biology." It is highly unlikely that this record of professional achievement by a single bird department staff will ever be attained again (Mayr 1975).

MAYR AND AMADON AND THE "NEW SYSTEMATICS" (1942–1973)

The attention of the Department's staff during its "golden years" was understandably focused upon increasing the size of the collections and housing them adequately, while field work was performed mainly by professional collectors with an emphasis upon acquiring large numbers of birds representing many different localities. This classical museum approach was remarkably productive and successful. Support for these activities had to be generated, for the most part, from sources outside of the Department.

The next three decades brought about not only a dramatic change in the manner in which staff research was financed, but also the establishment of a fund to support research of other ornithologists around the world. Staff members became more actively involved in collecting to fill gaps in the collections and to acquire material for specific projects. They also devoted time to teaching courses at a variety of colleges. The

Department took on the administration of a research field station within commuting distance of the Museum. Above all, however, there was a perceptible change, or at least a clearer focus, in the philosophical approach used by the curators in their research.

Ernst Mayr became the dominant force within the Department after Chapman's retirement. He played a major role in the unpacking and distribution of the Rothschild Collection, took charge of the planning and development of the Sanford Hall of the Biology of Birds, and exerted a major influence upon the research of other staff members. Although Mayr authored many taxonomic revisions and described many new taxa, his more influential contributions were in developing new theoretical and conceptual ways to view the formation of species and other evolutionary processes. Many of the titles were in collaboration with his Department colleagues (Delacour and Mayr 1945, Mayr and Amadon 1951, Mayr and Phelps 1967, Mayr and Short 1970). His *Systematics and the Origin of Species* (1942), one of the building blocks of the "Evolutionary Synthesis" with an impact on all of evolutionary biology, had a profound effect on the research orientation of not only his contemporary staff associates, but also on those who would follow him, and other ornithologists around the world. Later he taught courses on systematics and the origin of species at the University of Minnesota and the University of Washington at Seattle. Before Mayr left for an Alexander Agassiz Research Professorship at Harvard in 1953 (and later the Directorship of the Museum of Comparative Zoology), he had published over 200 titles, including several books, described over 300 new species and subspecies of birds, and left no doubt in the minds of his Museum colleagues what the functions and procedures of the "new systematist" should be.

As noted, Amadon's association with the Department began in 1937, when he assisted in the integration of the Philipp collection of eggs. He was appointed Assistant Curator in 1942 but spent the next three years on a leave of absence for service in the Army Medical Corps. During a tour in the South Pacific Amadon developed a keen interest in the birds of the islands of that region, which later aided him in writing some of the technical reports on the Whitney Expedition material. While stationed in Hawaii, he completed the first draft of a manuscript on the Hawaiian honeycreepers, a topic that he later developed into a doctoral dissertation at Cornell University in 1949. This would later appear as a Museum Bulletin (1950) and become a classic study of adaptive radiation in birds. Two other publications (Amadon 1949, 1966) are among the most cited references in discussions of subspecies and superspecies. Later in his career Amadon's research focused on birds of prey, culminating in a two-volume work co-authored with Leslie Brown (Brown and Amadon 1968). A beautifully illustrated monograph on the family Cracidae was co-authored with Jean

Delacour (1973). In 1954 Amadon held a visiting professorship at the University of Wisconsin, during which time he became acquainted with my research on the interrelationships of Eastern (*Sturnella magna*) and Western (*S. neglecta*) meadowlarks. As we shall see, such is the stuff from which staff appointments may develop. Amadon was the principal mover of the Hall of North American Birds, a memorial to Frank M. Chapman, which formally opened in 1964 on the 100th anniversary of his birth (Amadon 1964). Amadon chaired the Department from 1957 until 1973, a tenure in office surpassed only by that of Chapman. During his 40 years of service a tradition was established for which the Department is known around the world—"quiet scholarship amid a friendly climate that has maximized research productivity of staff and visitors." This quote is from introductory remarks made by Lester Short at a symposium held at the Museum to pay tribute to Amadon for his many significant and remarkably diverse contributions to ornithology (over 400 titles).

During this period there were from three to six research-oriented curators on the staff, but several served in the armed services in the early 1940s. Upon Chapman's retirement in 1942, Murphy assumed the chairmanship, a post that he held until 1954; he retired in 1955. Chapman, the acknowledged dean of American ornithologists, died in 1945. Zimmer followed Murphy as Chairman but poor health made it increasingly necessary for him to delegate the duties to others and he died early in 1957; Amadon became Chairman. Chapin continued his field work in the Congo (Fig. 4), interrupted during World War II by a trip to Ascension Island (for the Office of Strategic Services) where he documented (1954) the unusual annual "calendar" of the island's nesting Sooty Terns (*Sterna fuscata*). The first two volumes of his great work on *The Birds of the Belgian Congo* were published prior to his retirement in 1948; the remaining two volumes followed thereafter, thus completing one of the most important faunal studies in all ornithological literature (Chapin 1932–1954). Assistant Curator O'Brien assumed an increasingly important role throughout this period as he acquired progressively greater knowledge of the growing collections, handled the loan program, cataloging, and the countless other details that the research-oriented curators were happy to have him address.

Four new curators were added to the staff during this period. The first was E. Thomas Gilliard, whose long association with the Department began as a volunteer, in 1932. He was promoted to Assistant Curator in 1941, but had to devote several years to the United States Army, where he served with distinction in New Guinea and the Philippines. Gilliard later concentrated his research on the birds of the South Pacific, particularly New Guinea. Seven expeditions to that region resulted in a number of important publications, sometimes in co-authorship with his mentors (Mayr

Fig. 4. James P. Chapin and field assistant, in the Congo.

and Gilliard 1954, Rand and Gilliard 1968). His special interest was in the birds of paradise and bowerbirds and he proposed a provocative theory that in the more advanced bowerbirds artificial ornaments such as colorful shells replace and eventually supplant plumage ornamentation (Gilliard 1963, 1969, Fig. 5). Gilliard died in 1965, and Amadon (unpubl.) wrote in his annual report that year that the Museum "loses one of the few remaining explorer-naturalists of the earlier heroic stamp."

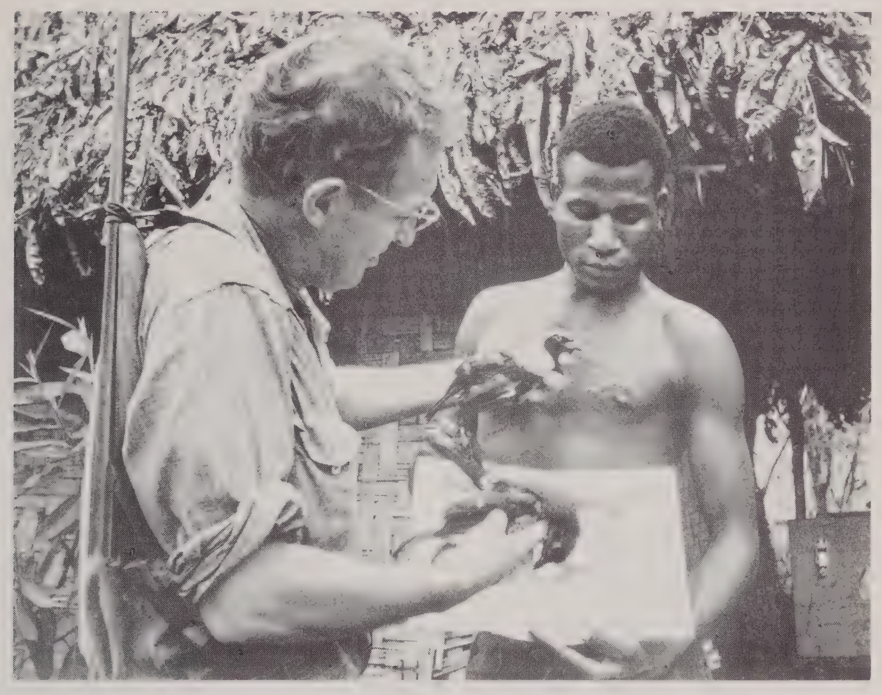

Fig. 5. E. Thomas Gilliard in the Adelbert Mts., Papua New Guinea, in 1959. He is comparing specimens of *Sericulus bakeri*, Fire-maned Bowerbird, with watercolor of the species painted by Joseph Sibal. The painting was made for Gilliard to take into the field to show local naturalists in hopes of rediscovering the species, first discovered by Rollo Beck in 1929 and not found again until Gilliard's 1959 expedition.

Charles Vaurie was the second addition to the curatorial staff during this period. Vaurie, a dentist in New York, began his career with the Department as a volunteer in 1942. Under the tutelage of Mayr he devoted more and more of his time to his "hobby." He was appointed Research Associate in 1946 and Assistant Curator in 1956, at which time he gave up his dental practice entirely. A great interest and competence in geography and cartography undoubtedly influenced Vaurie's selection of research projects, and it was in the meticulous documentation of avian distribution and geographical variation that he made his greatest contribution. The culmination of these efforts were two volumes on the birds of the Palaearctic (Vaurie 1959, 1965) and a treatise on the birds of Tibet (Vaurie 1972), all testimony to the painstaking research and meticulous thoroughness that characterized Vaurie's projects.

My appointment accounted for the third addition to the curatorial staff; my doctoral dissertation on the comparative behavior and ecology of the sibling species of North American meadowlarks had just been published (Lanyon 1957). I was anxious to pursue certain unanswered questions raised in that field study, and this desire was in harmony with Departmental needs. Murphy wrote in his 1946 Annual Report, "First among all departmental needs is the long-deferred implementation of our laboratories equipped for the study of living birds . . . The Department of Birds will never be able to realize its full opportunities in modern ornithological research until our various present endeavors are supplemented by controlled study of living and breeding birds in the well-equipped quarters which have thus far never been put to more than fractional use." Though complete renovation and modernization of these facilities would be delayed another decade until financial support could be secured, there was welcome movement in that direction with my interest in working with captive birds.

It was my (and the Department's) great fortune that within a year following my addition to the staff, a 100–acre estate on Long Island was bequeathed to the Museum by Augusta Kalbfleisch. I became the first and only Resident Director of the Kalbfleisch Field Research Station (in addition to curatorial duties in the Department) and inaugurated a series of research projects: a bird-banding program, maintenance and behavior of a variety of song bird species in controlled aviary and laboratory environments (Lanyon 1979a,b), and a long-term study of the succession of breeding birds on fallow Long Island farmland (Lanyon 1981).

In 1968 I worked with faculty of the City University of New York to establish a joint Museum/C.U.N.Y. graduate training program in Evolutionary Biology, was appointed an Adjunct Professor, and taught a graduate level course in the biology and systematics of birds of the world. In the following year, funds were supplied by C.U.N.Y. to renovate rooms on the sixth floor of the Department to be used by graduate students who would be based at the Museum.

In 1966 Lester L. Short, Jr. was appointed Associate Curator, having come from a position with the U.S. Fish and Wildlife Service at the United States National Museum. Short's interest in woodpeckers began with his graduate work at Cornell University on the relationships of eastern and western populations of flickers (Short 1965). Access to the Department's unrivaled collection of woodpeckers of the world gave him an enviable opportunity to extend his studies worldwide (Short 1972, 1973). Scholarly treatises on avian hybridization and speciation in birds in general, and in wood warblers and South American meadowlarks in particular, were soon to follow. He collaborated with Mayr in producing the influential *Species Taxa of North American Birds: a Contribution to Comparative Systematics* (Mayr and Short 1970).

The Department was quick to respond to the Museum administration's encouragement, during this period, to enlarge the roster of non-salaried Research Associates. Charles K. Nichols, a retired engineer, organized the department library, curated its collection of type specimens, and served as editor of the Ten-year Index to *The Auk* (Nichols 1960). Jean Delacour, an experienced aviculturist and one of the most active exponents of the world-wide conservation of natural resources, relinquished his salaried post with the New York Zoological Society in 1947 to give nearly full time to the Department. In 1952 he accepted the directorship of the Los Angeles County Museum of History, Science and Art but retained his Research Associate position. He authored an authoritative four volumes on the waterfowl of the world (1954–1964). William H. Phelps, Sr. of Caracas, Venezuela, had a long association with the Department, beginning with Chapman and Gilliard. Phelps' expeditions throughout Venezuela resulted in one of the largest and finest bird collections in South America. Phelps co-authored with his son an authoritative distributional checklist of the birds of that country (Phelps and Phelps 1950, 1958). The Phelps' types are housed in the Department in New York. William H. Phelps, Jr. also became a Research Associate in the Department and is perhaps best known for his *Guide to the Birds of Venezuela*, co-authored with Rodolphe Meyer de Schauensee (1978). The younger Phelps also collaborated with Mayr on an important study of *The Origin of the Bird Fauna of the South Venezuelan Highlands* (Mayr and Phelps 1967) and later contributed generously to support a series of expeditions to the isolated Cerro de la Neblina in Venezuela. Eugene Eisenmann, who gave up his law practice in New York to devote full time to birds, was appointed a Research Associate in 1957. Extensive field experience in Panama enabled him to assume Zimmer's role of handling inquiries on neotropical birds. He also served as a member of the International Commission on Zoological Nomenclature and provided much sought advice on nomenclatural matters. Perhaps his most influential publication was his *Species of Middle American Birds*, with distributions and recommended common names (Eisenmann 1955). Crawford H. Greenewalt is well-known to the ornithological community through two outstanding books: one in which he revealed his pioneering, photographic studies of hummingbirds (1960), and another on *Bird Song: Acoustics and Physiology* (1968) that stimulated a new wave of interest and experimentation in that field. James C. Greenway, Jr., shared an office with his good friend Delacour and co-edited with Mayr two volumes of Peters *Check-list of Birds of the World* (1960, 1962), produced three parts of a catalog of the type specimens of birds in the Department (Greenway 1973–1987) and provided generous financial support for many departmental activities. Paul Slud's residency in the Department was highlighted by publication by the Museum of his Bulletins on the birds of finca "La Selva"

(Slud 1960) and on the birds of Costa Rica (Slud 1964). Walter Bock was appointed Research Associate in the Department soon after he joined the faculty of Columbia University. Bock's research in avian anatomy and his publications on theoretical aspects of avian evolution, inspired by Mayr, have brought great credit to the Department (Bock 1973, 1974, 1979, 1988). Edwin O. Willis, who held a Research Associate position briefly, is best known for his pioneering field studies of ant-following birds in the neotropics (Willis 1972a,b).

In 1945 Research Associate Elsie M. B. Naumburg announced her decision to establish a fund in support of ornithological research, as a memorial to her late mentor, Frank M. Chapman, to be administered by the Department. The first Chapman awards (five) were made in 1951, totalling $1950. Mrs. Naumburg died in 1953, and her husband six years later. A bequest from the Naumburg estate brought the total endowment of the Frank M. Chapman Memorial Fund to about $300,000, and soon enabled the Fund to assume its present role as the single most important source in the world for support of only ornithological research. Traditionally most of these awards are to students doing postgraduate work, for travel, and purchase of research supplies, but not for salary. The list of recipients who have had their young ornithological careers initiated by such support is a lengthy one. In addition to this program of comparatively small awards, the Fund also provides salaried support for Chapman Fellows, most of whom conduct their research while in residence in the Department. The list of Chapman Fellows during this period of the Department's history reads like a "Who's Who Among Ornithologists:" William C. George, Lester L. Short, Jr., Erwin Stresemann, Douglas L. Lancaster, Allen Keast, Joe T. Marshall, Jr., Alexander F. Skutch, Edwin O. Willis, Charles T. Collins, Larry L. Wolf, François Vuilleumier, Joel L. Cracaft, and M. Philip Kahl.

Leonard C. Sanford, who directly or indirectly (through his influence with the Whitney family) was the Department's greatest patron, died in 1950. Fortunately he lived to witness the dedication of the Sanford Hall of the Biology of Birds (Fig. 6), marking the culmination of an idea conceived before occupation of the Whitney Wing. The Hall was not to have all of its alcoves completed, however, until 1962. Sanford left his collection of 16,000 specimens, largely of North American birds, to the Department. More importantly, from the standpoint of future research by staff, Sanford provided for certain trusts whose income is intended for support of the activities of the Department. Much of the Curators' research to this day is funded through the generosity of the Sanford family.

The Whitney Memorial Hall, upon which work was begun in 1929 and later interrupted by the war and its aftermath, was finally completed and dedicated in January 1953. The Hall is unique in several respects, including its over-all treatment of Pacific insular landscapes and bird life,

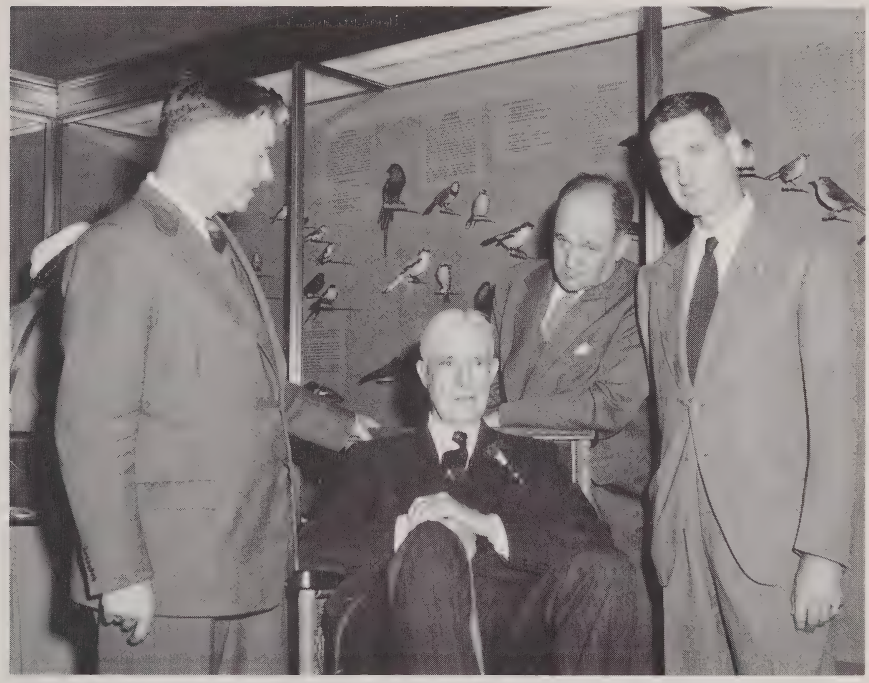

Fig. 6. Dedication of the Sanford Hall of the Biology of Birds, May 1948. Seated: Leonard C. Sanford, Trustee. Standing, left to right: (1) Albert E. Parr, Director; (2) F. Trubee Davison, President; (3) Cornelius V. Whitney, Trustee.

and the fact that the dome and the backgrounds of 18 large habitat groups were painted by a single artist, Francis Lee Jaques.

The Department's staff during this period had its share of honors and recognition from professional peers in the AOU. All four of the new curators and eight of ten of the new Research Associates were to become Fellows of the AOU. Amadon served as President of the AOU (1964–66) and Eisenmann as editor of *The Auk* (1957–1959), as Vice-President (1967–1969), and as Chairman of the AOU's Committee on Classification and Nomenclature. The senior Phelps received the coveted Brewster Award in 1955 for his contributions on the birds of Venezuela, and I received the same award in 1968 for my collective publications on the comparative biology of meadowlarks, flycatchers, and wood warblers.

THE CONTEMPORARY YEARS (1973–1990)

Only time will tell what impact on North American ornithology has been made by the Department's staff during the two most recent decades (Fig. 7). Among the more outstanding developments during these contemporary years was the receipt of funds from the National Science Foundation to improve the collections and to complete the renovation and refurbishment of the sixth floor laboratories, the emergence of a second field research station administered by the Department, the appointment of the Department's first salaried scientific assistants, and the growth of an in-house training program for graduate students in ornithology. Two new curators were appointed, but the retirements of O'Brien and Vaurie in 1973, Amadon in 1976, and my retirement in 1988 temporarily reduced the staff to three curators on each occasion.

After retirement Vaurie divided his time almost equally between the museums in Paris and New York where he continued his taxonomic revision of the ovenbirds (Furnariidae). Upon his death in 1975, the manuscript was seen through to publication by his colleagues on the staff (Vaurie 1980).

I served as Chairman from 1973 to 1980, under the Museum administration's new policy of seven-year rotating chairmanships. During this period I completed research on meadowlarks at the Kalbfleisch Station, culminating in a demonstration of sterility in captive-bred hybrids (Lanyon 1979a). I also published a revision of the flycatcher genus *Myiarchus*, based on a 20-year study that incorporated the use of vocal characters and standardized playback experiments (Lanyon 1978). Later I concentrated my research on the near relatives of *Myiarchus* and a reconstruction of the phylogeny of the myiarchine flycatchers (Lanyon 1985) and other monophyletic assemblages of tyrant flycatchers (e.g., 1988), using a variety of shared derived character states of the cranium and syrinx and, secondarily, nesting behavior and external morphology.

Short followed me as Chairman, from 1980 to 1987. His nearly 20 years of research on woodpeckers was brought together in a comprehensive monograph on the woodpeckers of the world (Short 1982). Short then focused his field work on the systematics and behavior of African honeyguides and barbets (Short and Horne 1983), and contributed the sections on these groups, as well as woodpeckers, to the handbook on the birds of Africa (Fry et al. 1988). Attention was devoted to a comparison of barbets and woodpeckers in Africa and South America (Short 1985). His search for the Cuban Ivory-billed Woodpecker (*Campephilus principalis*) resulted in his being named special consultant to the Cuban government in the latter's efforts to preserve that endangered species. Short also contributed to the

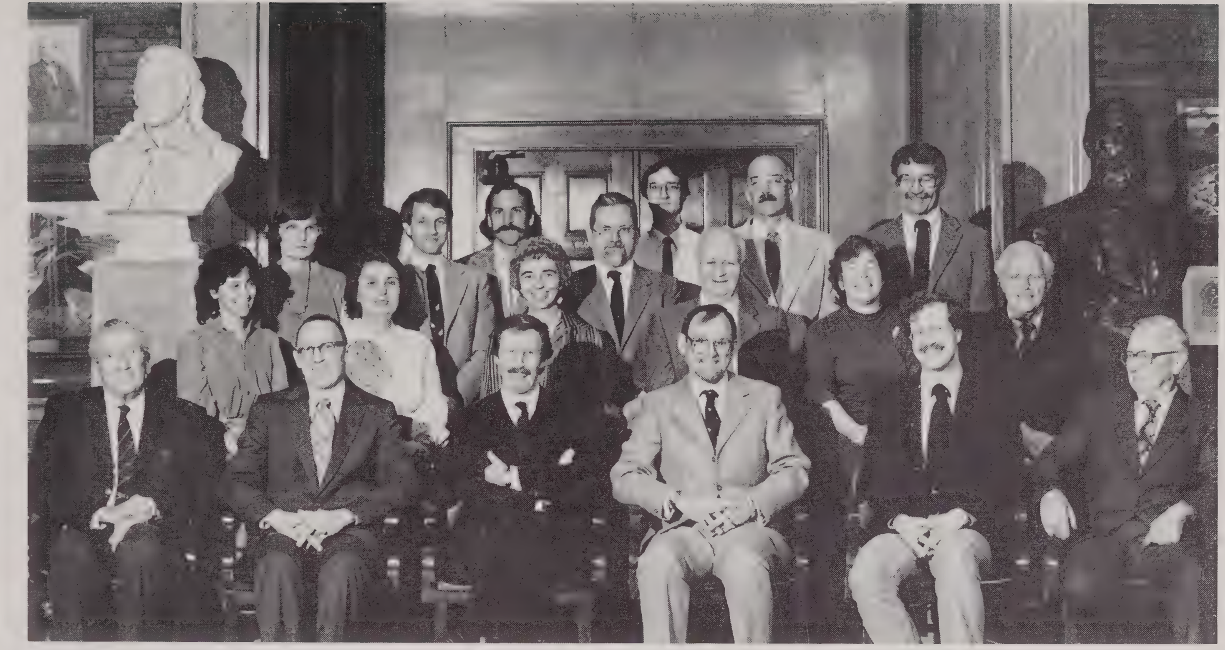

Fig. 7. Departmental photograph, 1983. Seated, left to right: (1) William H. Phelps, Jr., Research Associate; (2) Wesley E. Lanyon, Lamont Curator of Birds; (3) François Vuilleumier, Curator; (4) Lester L. Short, Chairman and Curator; (5) George Barrowclough, Assistant Curator; (6) Dean Amadon, Lamont Curator of Birds Emeritus. Second row, left to right: (1) Ivy Kuspit, Secretary; (2) Ruth DeLynn, Associate; (3) Mary LeCroy, Senior Scientific Assistant; (4) Allan O'Connell, Senior Museum Technician; (5) Helen Hays, Chairman, Great Gull Island Committee; (6) John Bull, Senior Scientific Assistant. Third row, left to right: (1) Sylvia Hope, graduate student ; (2) Peter Cannell, graduate student; (3) Jay Pitocchelli, graduate student; (4) Walter Bock, Research Associate; (5) James Drobnick, Secretary; (6) John Farrand, Jr., Associate; (7) Robert W. Dickerman, Research Associate.

AOU's production of the Sixth Edition of the *Check-list of North American Birds* (Eisenmann et al. 1983).

François Vuilleumier, who received his graduate training under Ernst Mayr at Harvard and had previously held a Chapman fellowship in the Department, was appointed Associate Curator in 1974. Vuilleumier's research interests are in discerning patterns of avian speciation and zoogeography, particularly in the Andes (Vuilleumier 1972, 1985a, Vuilleumier and Ewert 1978, Vuilleumier and Monasterio 1986, Vuilleumier and Simberloff 1980). He has published important papers on faunal turnover, fossil avifaunas, and avian diversity in South America (1984, 1985b, 1988). Vuilleumier succeeded Short as Chairman in 1987.

George Barrowclough, appointed Assistant Curator in 1979, is the most recent addition to the Department. Interested in examining evolutionary processes and heavily committed to the use of molecular and mathematical analyses in his research, Barrowclough brought refreshingly new approaches to the staff's investigations into avian systematics (Barrowclough 1980a,b, 1983; Barrowclough et al. 1985). He equipped one of the sixth floor rooms as a biochemical systematics laboratory, and initiated a long-term project to examine geographical variation in genetic and phenetic differentiation in the genus *Junco*. Under a grant from the U.S. Forest Service, Barrowclough studied geographic differentiation of electrophoretic variation in Spotted Owls (*Strix occidentalis*) as a contribution toward developing a management program for that endangered species (Barrowclough and Coats 1985).

Seven new Research Associates served during these contemporary years. Two of these were in residence throughout most of the period and made significant contributions to the Department. Stuart Keith is known to many amateur birders as the first President of the newly organized American Birding Association; but to a much larger audience world-wide he will be remembered for his studies of the birds of Malagasy and Africa (Keith 1980), and as co-editor of two volumes on the birds of Africa (Urban et al. 1986, 1988). Robert Dickerman assisted the staff in the care and improvement of the collections, particularly in the preparation of specimens, published on the systematics of a variety of New World species (Dickerman and Phelps 1982), and led a collecting expedition to Liberia. Jared Diamond, though not a resident research associate, visited the Department frequently to pursue his studies of the systematics, distribution, and behavior of the birds of New Guinea (Diamond 1977, 1984, 1987). Diamond was the recipient of a MacArthur Award, the first ever to a staff member of the Museum. Research Associate Robert Rockwell, a member of the faculty of the City University of New York, assists in the training of graduate students based in the Department, and has collaborated with staff members in analyzing data from his long-term field studies on the population biology of the Lesser Snow Goose (*Chen caerulescens*) (Rockwell and Barrowclough 1987). Other Research Associates during the contemporary years were Robert Bleiweiss, Cheryl F. Harding, and H. Philip Zeigler. Research Associate Eisenmann died in 1981, prompting a memorial volume published by the AOU to which several staff members contributed chapters (Bock 1985, Lanyon 1985, Short 1985, Vuilleumier 1985a).

For the first time in its history, the Department was permitted to have salaried scientific assistants, beginning with the appointment of Mary LeCroy, followed by that of John Bull and Allison V. Andors. LeCroy formerly had been associated with the Department as an assistant to Gilliard, an affiliation that led to her personal interest in the birds of New Guinea and particularly in birds of paradise and bower birds. She conducted a number of field studies of her own in Papua New Guinea (LeCroy 1981, LeCroy et al. 1980), and collaborated with Research Associate Diamond (Diamond and LeCroy 1979). A series of books and papers left unfinished by Gilliard's untimely death were completed largely through Mrs. LeCroy's efforts (e.g., Gilliard 1969). Through his publications, *Birds of the New York Area* (1964) and *Birds of New York State* (1974), John Bull continued in the tradition established by Chapman's pioneering handbook and Griscom's book on the New York region. Bull has been responsible for establishing the Department's much used reference series of the species of birds of the world. Andors' research has focused on the giant flightless North American *Diatryma* and related extinct birds (Andors 1991). Noteworthy among his valuable contributions has been the curating of the Department's anatomical collection.

The Department continued administering the Frank M. Chapman Memorial Fund, and by the end of this period the market value of the Fund was nearly $4,000,000. Fifty to 70 awards were being made each year, totalling from $35,000 to $50,000. Chapman Fellows during the contemporary years were: F. Gary Stiles, David J. T. Hussell, Richard R. Olendorff, Hans Winkler, Julian Ford, Malcolm C. Coulter, Robert C. Eckhardt, Glen E. Woolfenden, Philip Gaddis, Timothy Crowe, Robert M. Zink, Robert E. Bleiweiss, David R. Wells, Mary C. McKitrick, Nina Pierpont, Jonathan Becker, Angelo P. Capparella, Richard O. Prum, C. Craig Farquhar, Jeffrey G. Groth, Jean L. Martin, and C. Jeffrey Woodbury.

The Department's involvement with formal graduate-level teaching programs accelerated during the contemporary years, with staff members advising graduate students not only from the United States but also from Mexico, Kenya, Chile, and France. As a direct result of the joint graduate training program developed with the City University of New York, the

Department was successful in obtaining the first award ever made to the Museum by the National Science Foundation for direct support of a program in graduate education. The grant made possible the construction and refurbishment of laboratory and classroom facilities on the sixth floor. Initially I, and later Short and Vuilleumier, held adjunct professorships at C.U.N.Y. and taught a graduate level course in the biology of birds of the world, offered every third or fourth semester. Graduate students participating in this program and based in the Department have been Michael Gochfeld, James Gulledge, David Ewert, Peter Cannell, Sylvia Hope, Francis Pitocchelli, Rosemarie Gnam, Mary Katz, and Patricia Escalante.

Support from the National Science Foundation for the department's collection-based activities has greatly improved the management of the collections and is testimony to their importance to the scientific community. These awards, among the first in the nation, provided for the hiring of a number of temporary curatorial assistants, from 1972 to 1979, to help the staff deal with a backlog of specimens, with cataloging, and to improve the level of service provided to the scientific community and to the general public. The program for loan of specimens to qualified investigators at other museums throughout the world is large and labor intensive, with an annual average of 250 shipments involving over 4000 specimens. An important result of the NSF grants was the publication of a *Reference List of the Birds of the World* (Morony et al. 1975), a one-volume registry of the 9016 recent species of birds, designed to satisfy a variety of needs of the Department's staff, and those of a broad spectrum of amateur and professional ornithologists around the world.

In 1949 the Museum acquired legal title from the War Assets Administration to a tiny island off the northeastern tip of Long Island, known as Great Gull Island. The site of a fort for over 50 years, the island had previously been a place where terns nested. It was hoped that if the island was protected terns would return. The Museum entrusted the administration of the island to a committee on which the Department and the Linnaean Society of New York were represented. Helen Hays, appointed in 1969, is the present Chairman of the Great Gull Island Committee. Hays was the first woman President of the Linnaean Society of New York, and her volunteer program to carry out the labor-intensive banding on Great Gull Island received President Reagan's Volunteer Action Award in 1985. With enlarged nesting areas in the last ten years, the number of nesting Common Terns (*Sterna hirundo*) has almost tripled to 17,000 birds and Roseate Terns (*S. dougallii*) number about 2600. Nearly 10,000 young are banded each year. Over 90% of the adults trapped annually have been banded previously, making this colony the greatest concentration of individually marked birds in the world. Another significant result of this program is the first demonstration that industrial chemicals could affect a wild population of animals (Hays and Risebrough 1972). High concentrations of PCBs were found in abnormal young as well as in bait fish. Hays and her colleagues also documented polyandry in Spotted Sandpipers (*Actitis macularia*) not previously described in any sandpiper (Hays 1972), and hybrids between Roseate and Common terns (Hays 1975). A recent grant enabled the project to computerize 26 years of data for future analysis.

Throughout its long history the Department has been keenly aware of the need for preserving birds and their habitats. Chapman and Murphy were elected honorary presidents of the National Audubon Society, and Murphy spearheaded pioneering efforts to control the use of insecticides. Murphy was the first President of the Long Island Chapter of the Nature Conservancy, and I later served on that Chapter's Board of Directors. Delacour was President of the International Council for Bird Preservation (ICBP), Phelps, Jr. was Chairman of the Pan-American Section of ICBP, and other staff members have been active in both the United States Section and the Pan-American Section of that organization. Short chaired the Woodpecker Specialist Group of the International Union for the Conservation of Nature and Natural Resources, and Vuilleumier (1988) has contributed to our understanding of the optimal size and number of parks and reserves for preserving unique South American ecosystems.

Recognition of the Department's staff by its professional peers during these contemporary years resulted in my serving as President of the AOU (1976–1978) and Bock being awarded the AOU's Coues Award (1975) for his studies in avian anatomy. All of the Department's curators are Fellows in the Union, and Bock was named the first Permanent Secretary of the Executive Committee of the International Ornithological Congress (IOC). Ernst Mayr served as President of the IOC in 1962. Further testimony to the Department's standing in ornithology came in 1986, at the 19th IOC in Ottawa, where seven of the 50 invited symposia were convened by persons associated with the Department. No other institution was represented by more than two selected convenors. I was engaged to review and evaluate the resources and operations of the bird departments at the Museum of Zoology, University of Michigan, the Carnegie Museum, and the United States National Museum.

Still another measure of the contribution to North American ornithology made by the Department is the frequency with which the AOU has accepted invitations to hold its annual meetings in New York. As noted above, the AOU was founded at the American Museum in 1883, and additionally deemed it "appropriate and proper" that it should also hold its 50th and 100th anniversary meetings in New York. Of the 108 stated meetings that have been held through 1990, the AOU has met at the American Museum 19 times, considerably more than at any other institution. The Centennial Meeting in 1983 was a gala affair and thought to be the largest known gathering of ornithologists up to that time, with 1177 registrants representing 21 countries, 48 U.S. states, and nine Canadian provinces. Quoting the Proceedings that year, "The events, exhibits and support for the Centennial Meeting were unrivaled by those at any other AOU meeting. The Local Committee and Program Committee, and the Board of Trustees, Director, and staff of the American Museum of Natural History devoted resources and energy to ensure that the meeting constituted a fitting celebration of the founding of the Union . . . the Centennial banquet . . . with abundant libation, excellent food, announcements of awards, and a dance band has been judged by those who attended as the most elegant, elaborate, and festive banquet in the history of American ornithology" (Power 1984).

ACKNOWLEDGMENTS

Grateful acknowledgment is made to Ernst Mayr, Dean Amadon, François Vuilleumier, Mary LeCroy, and Helen Hays for constructive comments and criticism of all or portions of the manuscript.

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6

Ornithology at the Field Museum

Peter E. Lowther[1]

Abstract.—The Field Museum was founded as a direct result of the 1893 World Columbian Exposition at Chicago. The private collection of C. B. Cory established the research collections and Cory became the museum's first Curator of Birds. Following Cory, the succession of ornithology curators include J. T. Zimmer, C. E. Hellmayr, H. B. Conover, W. R. Boulton, A. L. Rand, E. R. Blake, M. A. Traylor, Jr., J. W. Fitzpatrick, S. M. Lanyon, and A. T. Peterson. Major contributions to avian systematics include the Field Museum's *Catalogue of the Birds of the Americas*, begun by Cory in 1918, continued by Hellmayr, and completed by Conover in 1949. Blake and Traylor were involved in completion of Peters' *Check-list of Birds of the World.* Early curators undertook works of discovery and published descriptive faunal and taxonomic studies. Subsequent work encompasses systematics with a more comprehensive view of evolutionary and ecological foundations. Since the 1980s, curators have become involved with graduate programs at nearby Chicago universities and molecular techniques are now part of systematic work at the Field Museum. Collection size currently is near 400,000 specimens with current strengths in Neotropical taxa although all bird families are represented excepting Atrichornithidae.

The Field Museum came into existence as a result of the 1893 World's Columbian Exposition, in Chicago, Illinois. At the conclusion of the Exposition, Edward E. Ayer convinced Marshall Field to finance the establishment of a museum. The Columbian Exposition provided the initial building and much of the original exhibit material and collections, and demonstrated to the "East" that culture and civilization existed in the

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"West," as well. The official name of The Field Museum has changed several times during its existence. The museum was founded in 1893 as the "Columbian Museum of Chicago," but became the "Field Columbian Museum" the following year. In 1905, it was renamed the "Field Museum of Natural History." From 1943 to 1966, the name became "Chicago Natural History Museum," but afterwards its name was restored to "Field Museum of Natural History." During the museum's centennial year, the institution publically became "The Field Museum." I use the name "Field Museum" throughout this history. The museum initially occupied the Fine Arts building of the Columbian Exposition (now occupied by the Museum of Science and Industry) and moved into its present structure in 1921.

CURATORS AND THE DEVELOPMENT OF ORNITHOLOGY AT THE MUSEUM

Persuasion from Edward Ayer and several museum trustees brought the private bird specimen collection of friend and business associate C. B. Cory to the Field Museum and established a research collection there.

Charles Barney Cory (1857–1921) was born into a wealthy importing family. His family encouraged his natural history proclivities during his youth and as an adult he continued to pursue these interests. Cory was a proper gentleman naturalist of the day. He attended the 1883 organizational meeting of the American Ornithologists' Union (AOU), and in addition to being a founder of the AOU, Cory served terms as Treasurer, Councillor, Vice President and President (1903–1905). He travelled and collected widely, visiting Egypt, Florida, the southwestern U.S., Canada, and the West Indies, and frequently employed collectors on his travels.

In 1893, Cory and his private collection began their association with Field Museum. In exchange for his collection of about 19,000 specimens, Cory was named Curator of Ornithology (for life) without residence obligations. Initially this association was a very casual relationship for Cory. He augmented his collection and occasionally visited Chicago, but assistant curators at the Field Museum provided the curatorial services, and during this early period, D. G. Elliott was curator in residence and held responsibility for the bird collection. Initially Elliott was head of the "Department of Zoology, except Ornithology," a department designation resulting from the acquisition of Cory's collection. Assistant Curators included George K. Cherrie (from 1894 to 1897), W. A. Bryan (1898), and Ned Dearborn (1904–1908). Dearborn and John Ferry actively collected in the West Indies and Central and South America. In 1906, Cory lost his personal fortune and his relationship with the Field Museum changed from absentee curator to

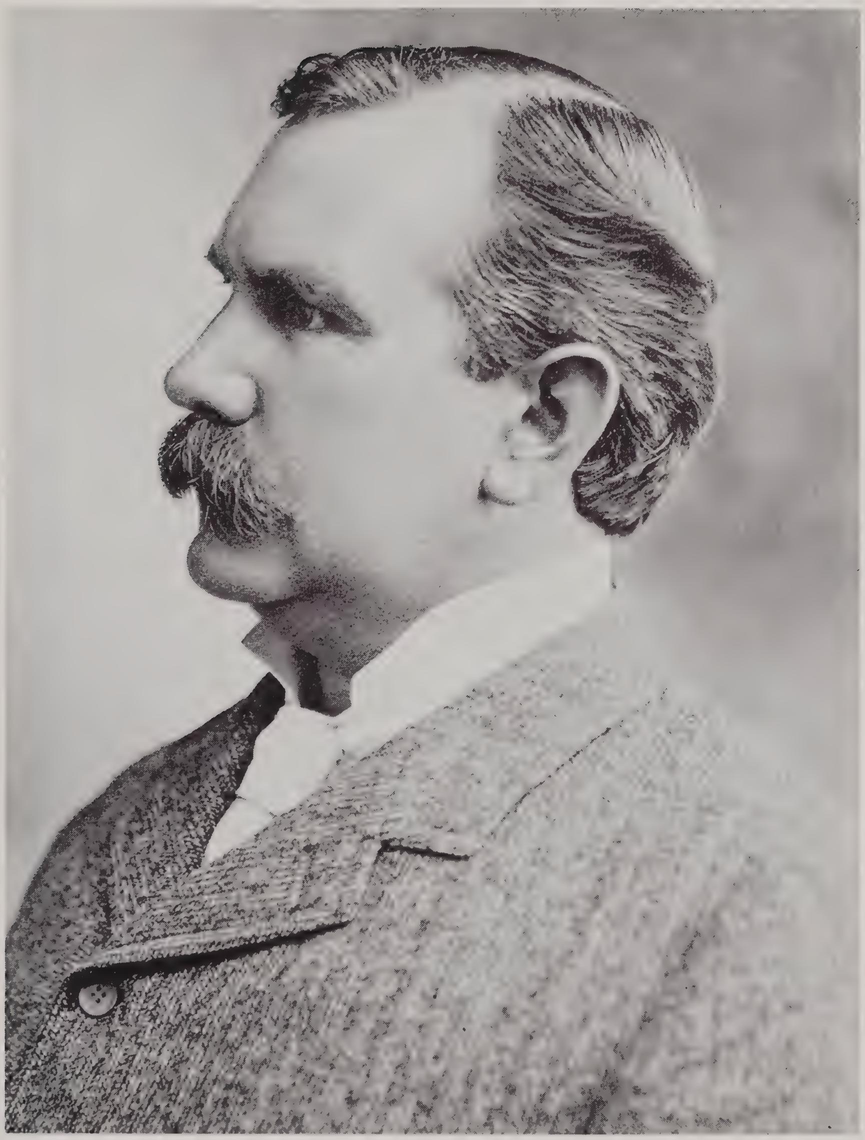

Fig. 1. C. B. Cory about 1910. (The Field Museum, Neg. # 44704, Chicago.)

a salaried Curator of Zoology (the Department of Ornithology became part of the Department of Zoology). While at Chicago, Cory produced *The Birds of Illinois and Wisconsin* (1909) and began the series *Catalogue of*

Birds of the Americas and the Adjacent Islands in Field Museum of Natural History, completing the first two volumes on his own (Cory 1918, 1919). At his death he left manuscripts for three additional volumes which were completed by C. E. Hellmayr (Cory and Hellmayr 1924, 1925, 1927). (See also Osgood 1922 for biographical information.)

John Todd Zimmer (1889–1957), Curator of Birds from 1922 to 1930, produced *Catalogue of the Ayer Ornithological Library* (1926) while at the Field Museum. Zimmer participated in the Conover-Everard African Expedition and the Marshall Field Peruvian Expedition. This latter expedition marked the beginning of his work on South American birds which was completed later at the American Museum of Natural History. He also served on the AOU Check-List Committee for the 4th and 5th editions. (See also Murphy and Amadon 1959 for biographical sketch.)

Carl Eduard Hellmayr (1878–1944) obtained his expertise in Neotropical birds in the museums of Europe (Haffer 1994) and was an Honorary Fellow of the American Ornithologists' Union. After Cory's death, Hellmayr was engaged to complete the *Catalogue of the Birds of the Americas* and served as a Field Museum curator from 1922 to 1931. Hellmayr is the best known author of the *Catalogue of Birds of the Americas*, since he did work on most of the series (Cory and Hellmayr 1924, 1925, 1927; Hellmayr 1929, 1931, 1934, 1935, 1936, 1937; Hellmayr and Conover 1942; 1948a,b; 1949). He expanded the synonymies in the *Catalogue* and the volumes he produced became one of the primary references on New World birds. (See also Zimmer 1944.)

(Henry) Boardman Conover (1892–1950) was associated with the Field Museum from 1920 until his death. In 1919, Conover met W. H. Osgood, an Assistant Curator of Mammalogy and Ornithology at the Field Museum. Under Osgood's guidance, Conover's interest in wildlife and hunting turned toward scientific activities. Conover participated in his first museum expedition, to Venezuela, in 1920. Inspired by this trip, he abandoned business and began a full time avocation as ornithologist. Conover participated in additional expeditions for the Field Museum: Argentina (1922), Brazil (1923), Alaska (1924), and Mexico (1925). In 1926, Conover and R. H. Everard financed an expedition to east Africa. Conover's private collection of "game" birds (defined by him to include Tinamiformes, Anseriformes, Galliformes, Gruiformes, Charadriiformes, and Columbiformes), begun in 1920, was housed at the Field Museum. As a result of his own collecting efforts, augmented by hired collectors, personally sponsored expeditions, and exchange, Conover's collection reached 18,000 specimens and included 30 types. He was named Honorary Associate in 1924, appointed Research Associate in 1936, and joined the Board of Trustees of the Museum in 1940. Because of his many gifts to the Field Museum, he is now listed as a Benefactor. As Research Associate,

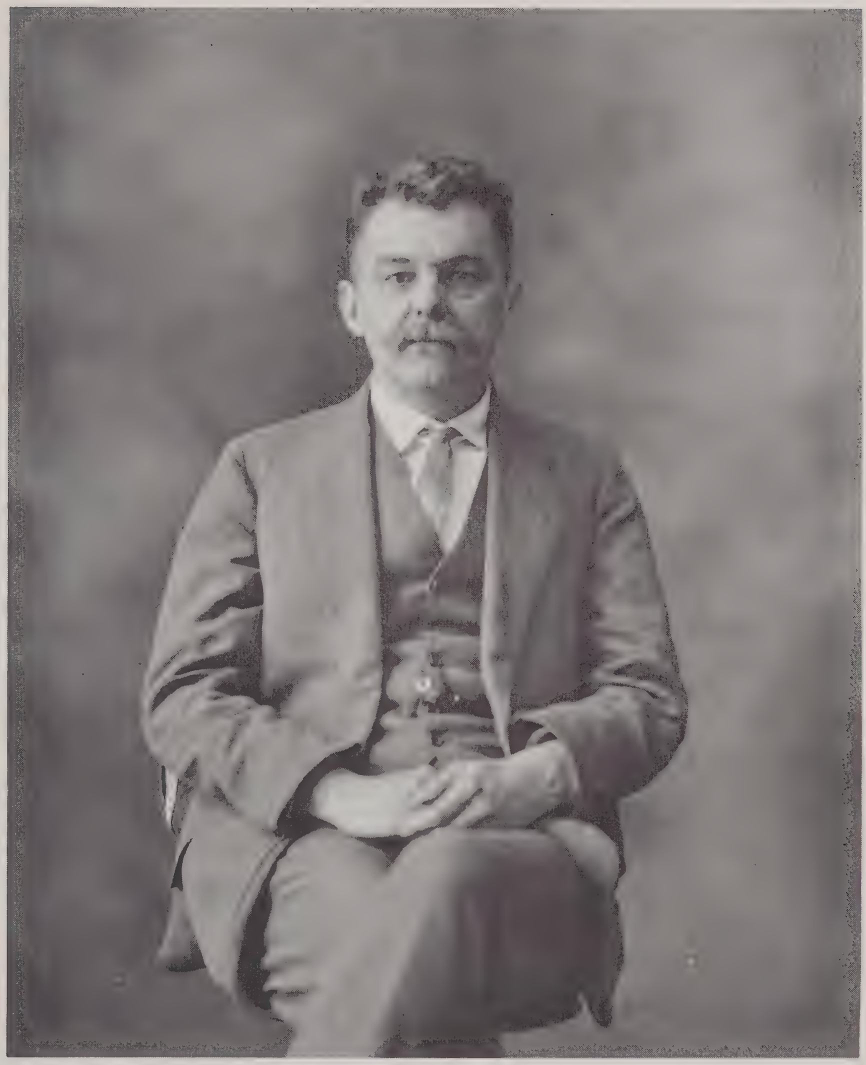

Fig. 2. C. E. Hellmayr about 1925. (The Field Museum, Neg. # 48807, Chicago.)

Conover completed the final four volumes of *Catalogue of the Birds of the Americas* from Hellmayr's manuscripts (Hellmayr and Conover 1942; 1948a,b; 1949). He was elected a Fellow of the AOU in 1947 in recognition of this work. (See also Gregory and Rand 1951 for biographical information.)

Fig. 3. H. B. Conover as Museum Trustee in 1944. (The Field Museum, Neg. # 82919, Chicago.)

Wolfrid Rudyerd Boulton (1901–1983) served as Curator of Birds from 1931 to 1946. Boulton's professional experience included work at the American Museum of Natural History and Carnegie Museum where he participated in several African expeditions (Masterson 1983). While curator he took part in several expeditions, returning to Africa and travelling to the West Indies and Galapagos Islands. Besides building the Field Museum's collections, Boulton was instrumental in developing a hall of birds for public display (a display that remained intact until its re-design in 1992). After his career with the Field Museum, Boulton settled in Zimbabwe where he became active in conservation and ornithological activities (Masterson 1983).

World War II resulted in a leave of absence for many staff. During 1943 to 1945, volunteer Ellen Thorne Smith (1904–1977) was the only staff member actually working in the Bird Division. Smith provided many years (1936–1977) of volunteer work with the Bird Division and was founder of the Field Museum's Women's Board, a group active in fund raising for the museum (Traylor and Webber 1977). A major renovation and expansion of research and collection space was financed by a contribution honoring Smith.

Emmet R. Blake (1908–) came to the Field Museum in 1935. He had previously participated in a National Geographic Society boundary survey team for Brazil (1930), and expeditions to Venezuela (1932), Guatemala (1933–1934), and British Honduras (Belize; 1935). As curator he made trips to British Guiana (Guyana; 1937, 1938), Brazil (1937), and Peru (1958). While at the Field Museum Blake produced *Birds of Mexico: a Guide for*

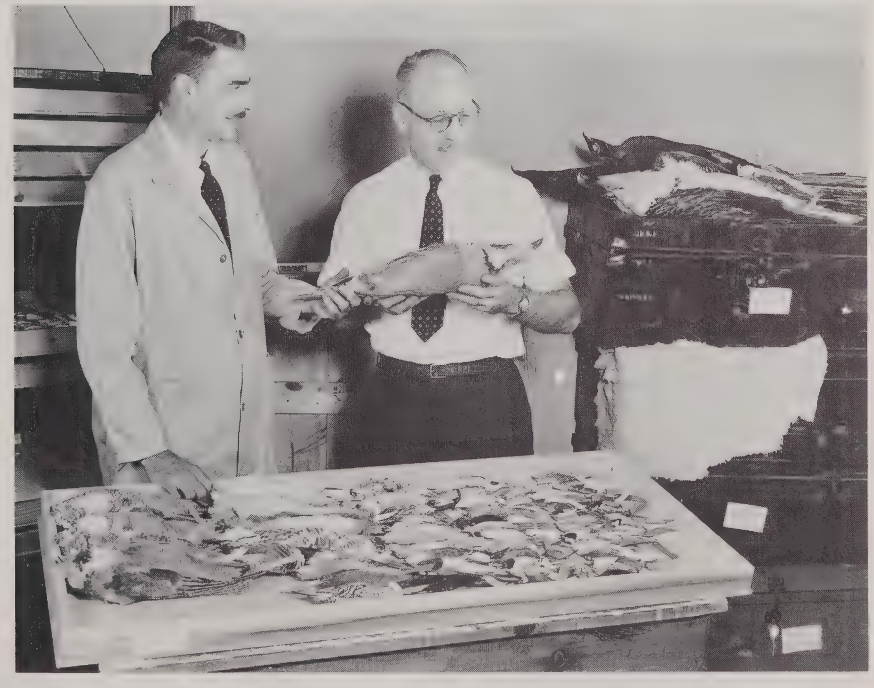

Fig. 4. M. A. Traylor, Jr., (left) and E. R. Blake in 1956. (The Field Museum, Neg. # 86738, Chicago.)

Field Identification (1953) based on his field experience in Mexico and museum collections. Blake served as Curator, excepting war service, until 1973, but continues his work on neotropical birds as Curator Emeritus. The first volume of his major work, *Manual of Neotropical Birds,* was published (1977) and he contributed to Peter's *Check-list of Birds of the World* (Blake 1979). (See also Nelson 1990.)

Austin Loomer Rand (1905–1982) served as Curator from 1947 to 1955 and then Chief Curator of Zoology until 1970. Rand served as a bridge from an era when primary interests were in subspecies descriptions and faunal lists to a time when evolutionary patterns, behavior and ecology took center stage. Of the 103 papers produced during his Field Museum tenure, 52 dealt with systematics or faunal surveys, and 51 were on glaciation and speciation, altitudinal variation, enemy recognition, and other behavioral and ecological subjects. He produced a book on New Guinea birds (Rand and Gilliard 1967) and an ornithology textbook (Rand 1967). Major collections from Andean South America, east and west Africa, Iran, India, Nepal, and the Philippines were made during his tenure, and by exchange, the Field Museum gained an important representation of New Guinea birds. (See also Traylor et al. 1984.)

Melvin A. Traylor, Jr., (1915–) began his association with the Field Museum as a volunteer collector in Mexico during 1937 and 1939. Except for war service, Traylor continued to work as an expedition collector and unpaid associate until 1952 when financial problems ended his career as a "gentleman" scientist. In 1956, Traylor returned to the Field Museum as an Assistant Curator when the position became available. Traylor joined Harry Hoogstraal on an expedition to Egypt and the Sudan (1959). He travelled again to Africa (1961), visiting Northern Rhodesia (Zambia), Southern Rhodesia (Zimbabwe), and Bechuanaland (Botswana). His last expedition was to the Sudan (1977). He served as Curator until 1980 (including three years as Chairman of Zoology) and has continued his research activities as Curator Emeritus. Traylor is known for his taxonomic work on New World flycatchers (Traylor 1977, 1979) and African Muscicapidae (Traylor 1986). His name is associated with many geographical areas, and his work on Angolan birds (Traylor 1963) and birds of Szechwan (Traylor 1967) are still the primary references for those areas. Traylor contributed to ornithological gazetteers for several South American countries (Paynter and Traylor 1977, 1981, 1991; Paynter et al. 1975, Stephens and Traylor 1983, 1985). (See also Nelson 1990.)

John Weaver Fitzpatrick (1951–) served as Curator from 1978 to 1989. Fitzpatrick's research interests include the systematics, evolution, and adaptive radiation of tyrannid flycatchers (e.g., Fitzpatrick 1985) and the distribution of birds in the Andes. Expeditions he led to Peru discovered six new species of birds. As a student, Fitzpatrick had joined G. E.

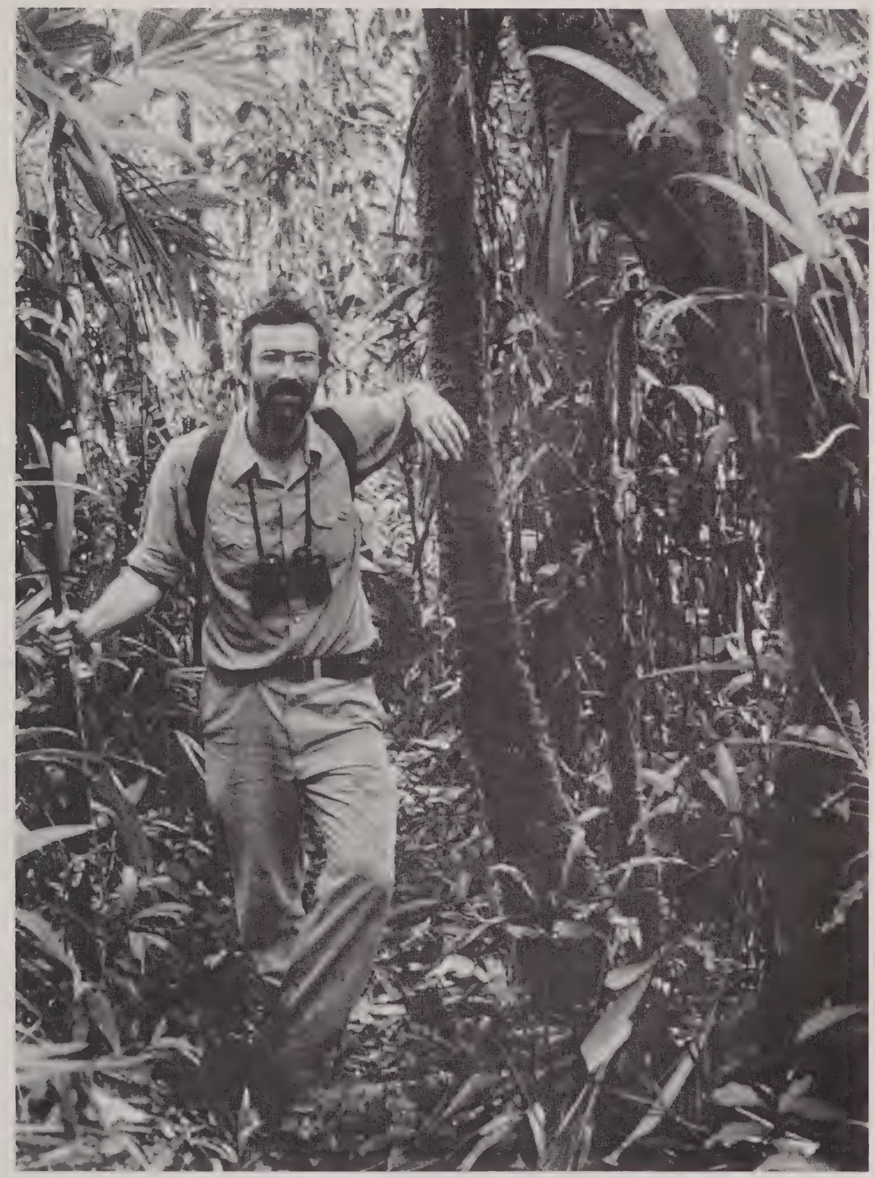

Fig. 5. J. W. Fitzpatrick collecting in Peru in 1986. (The Field Museum, Neg. # 84568.23A, Chicago.)

Woolfenden's long-term study of Florida Scrub Jay (*Aphelocoma coerulescens*) populations at Archbold Biological Station. He continued this association throughout his time at the Field Museum (see Woolfenden and Fitzpatrick 1984). In 1980, Fitzpatrick negotiated the transfer of Princeton University's bird collection (11,500 specimens) to the Field Museum to insure continued curatorial care. This was followed by transfer of Northern Illinois University holdings in 1988, and G. E. Woolfenden's collection in 1990. Fitzpatrick was the first Curator of Birds to become involved in graduate programs with nearby Chicago universities. Fitzpatrick became Director of Archbold when he left the Field Museum.

David Willard (1946–), came to the Field Museum with a doctorate from Princeton in 1978 to serve as the Division's first Collection Manager. In addition to collection maintenance, he has participated in expeditions to Peru, Bolivia, Brazil, Venezuela (Willard et al. 1991), Uganda, the Philippines, and the Marshall Islands. He instituted a salvage program of window-killed birds that has resulted in about 1000 local specimens being added per year to the collection since 1978. Catalog computerization took place under Willard's supervision.

Scott M. Lanyon (1956–) began his curatorship at the Field Museum in 1985, following his father's footsteps in an ornithological career. Lanyon's current major research interest is reconstruction of the phylogeny of the Icterinae (e.g., Lanyon 1992). His use of biochemical techniques required that he develop a laboratory which is now used by researchers in all museum departments and by many local graduate students. In conjunction with his research, he began a tissue collection that contains over 7000 samples of 1400 species. Lanyon's field work has taken him to Peru, Bolivia, Brazil (from where he described a new species), the West Indies and the Marshall Islands. Lanyon initiated the effort to computerize the Bird Collection catalog. Lanyon has expanded the Bird Division's involvement with graduate programs at the University of Chicago and the University of Illinois at Chicago.

Collection computerization began as data entry from catalog books in 1987 and was completed in 1990. Second phase editing to verify computer entry with specimen label began in 1993. General tabulations of collection holdings by taxonomy demonstrate the strengths of the Field Museum's bird collection (Tables 1, 2). Catalog computerization coincided with the expansion of computing support staff at Field Museum. Peter E. Lowther, with a doctorate in ornithology from the University of Kansas, began serving as Database Manager in 1987.

In addition to computerization and active field work in the Neotropics, the Bird Division has recently supported work in the Old World (e.g., Steven Goodman's field work in north and east Africa, Pakistan, Madagascar, and Philippines).

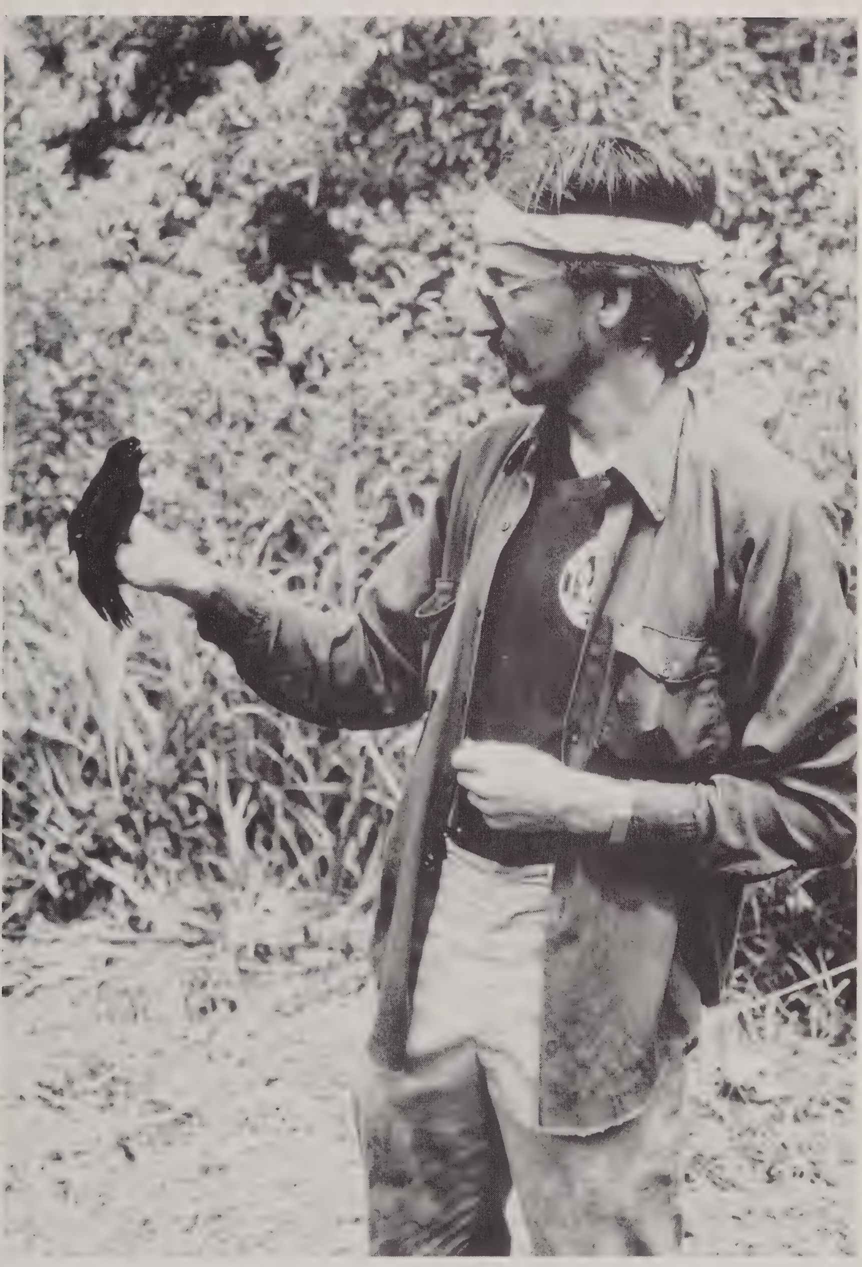

Fig. 6. S. M. Lanyon in Peru in 1986. (Photo copyright Barbara Clauson, used with permission.)

Andrew Townsend Peterson (1964–) was curator with the Field Museum from 1992 to 1993. His ties with the Field Museum began as a graduate student at the University of Chicago in 1985, working with both Fitzpatrick and Lanyon. Peterson worked on the phylogeny of *Aphelocoma* jays in Mexico and western U.S. (e.g., Peterson 1992). He left the Field Museum for a teaching and curation position at the University of Kansas.

Table 1. Major taxonomic components of the collection. Families with > 5000 study skins on 14 April 1994.

Family	*Skins*	*Skeleton*	*Spirit*
Accipitridae	7,015	436	21
Anatidae	8,414	865	17
Phasianidae	8,767	338	23
Scolopacidae	10,480	330	36
Laridae	5,671	626	8
Columbidae	12,522	1,235	141
Psittacidae	5,235	926	66
Cuculidae	5,107	153	56
Strigidae	5,251	536	34
Trochilidae	9,376	624	460
Picidae	10,990	402	118
Formicariidae	6,442	505	515
Tyrannidae	17,030	667	539
Pycnonotidae	6,767	416	195
Laniidae	5,262	61	36
Turdidae	17,507	2,252	352
Timaliidae	6,685	129	291
Sylviidae	12,792	395	237
Nectariniidae	6,168	315	172
Emberizinae	32,974	8,637	392
Icterinae	9,453	545	111
Parulinae	19,184	3,437	252
Thraupinae	10,705	452	303
Fringillidae	8,044	483	122
Estrildidae	5,680	1,191	111
Ploceidae	5,297	351	98
Corvidae	6,144	412	95

Table 2. Geographic representation of Field Museum bird collection. Countries or regions with > 5000 specimens on 14 Apr 1994.

North America		Asia	
Canada	7,545	India	15,130
USA	104,921	Nepal	7,261
Mexico	12,228	Philippines	19,974
West Indies	14,806		
		Africa	
South America		Cameroon	8,464
Bolivia	10,398	Kenya	12,941
Brazil	13,583	Uganda	8,623
Colombia	13,527		
Peru	17,835		
Venezuela	6,817		

MEETINGS HOSTED

The Field Museum has hosted three meetings of the American Ornithologists' Union. Soon after the "new" building was opened in 1921, the Field Museum hosted the 40th Stated Meeting of the American Ornithologists' Union held jointly with the 8th Annual Meeting of the Wilson Ornithological Club (now Society). About 150 individuals attended and 44 papers were presented (Palmer 1923). A group picture from the meeting was published in *The Wilson Bulletin* (Ganier 1923). The American Ornithologists' Union again met at the Field Museum for its 52nd Stated Meeting in 1934, with 270 attendees and 62 papers (Palmer 1935). At the third gathering hosted by the museum, AOU's 100th Stated Meeting in 1982, attendance reached 710 individuals and 280 papers (Power 1983).

ORNITHOLOGICAL COLLECTIONS

At present, the bird collection of Field Museum numbers approximately 390,000 specimens. All families (excepting Atrichornithidae) and about 7500 species are represented in its holdings. The strongest representations are of North American species (all species), Neotropical and Ethiopian (about 95% of both regions), and the Philippines and India. The study skin collection ranks third among North American collections (Banks et al. 1973) and is fourth world-wide. Skeletal holdings rank seventh in the world and fluid-preserved material ranks tenth (Zusi et al. 1982). Growth

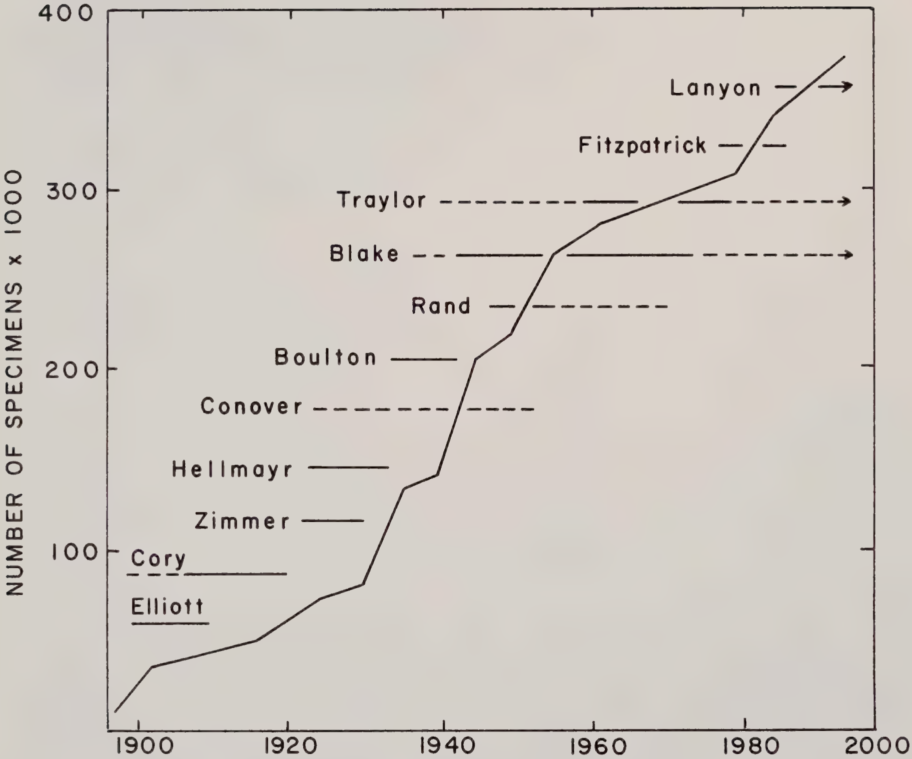

Fig. 7. Growth of Bird Collection at The Field Museum. Tenures of curators in charge are indicated as solid lines; dashed lines show non-curatorial associations.

of anatomical holdings has been a recent event with fluid-preserved material doubling in the past 10 years and skeletal holdings increasing 5-fold during this same period. The Field Museum's egg collection ranks sixth in North America (Kiff 1979). Recent loan activity has averaged about 70 loans totalling 2000 specimens per year. Over 100 visitors per year examine collection material at the museum.

ACKNOWLEDGMENTS

I thank Emmet Blake, Melvin Traylor, John Fitzpatrick, Scott Lanyon, and David Willard for their comments and suggestions. Mary Ann Johnson and M. Diane Mauer also assisted in researching specific questions. Nina Cummings searched Field Museum photo files for illustrations. Barbard Clauson provided the photograph of Lanyon.

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Ornithology at Carnegie Museum of Natural History

Kenneth C. Parkes[1]

Abstract.—The history of ornithology at Carnegie Museum of Natural History in Pittsburgh, Pennsylvania, is dominated by its first Curator of Birds, W. E. Clyde Todd (1874–1969). Only two other persons have held that title: Arthur C. Twomey, in the years 1946–1961, and Kenneth C. Parkes, 1962 to date. Persons who have held other positions in the Section of Birds are listed. The size and scope of the collections, which are strongest in birds of the Western Hemisphere, are given. The Section operates a major bird-banding program at the Museum's field station, Powdermill Nature Reserve, in Westmoreland County, Pennsylvania. The collections, library, and other facilities are ideally suited for traditional museum-based studies of avian systematics that provide a context for research employing newer techniques.

The histories of ornithological departments of a few museums are dominated by individual curators. One thinks, for example, of Josselyn Van Tyne at the University of Michigan, George Lowery at Louisiana State University, and Alden Miller at the University of California at Berkeley. None of these, however, matched the longevity record of W. E. Clyde Todd at the Carnegie Museum of Natural History. Todd joined the Carnegie staff in 1899 at 25 years of age, and retired in 1945. Furthermore, he continued to commute to the museum by train from his home in Beaver, Pennsylvania, some 40 miles away, for 24 years after his formal retirement. The history of the first half century of ornithology at Carnegie is thus over-

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whelmingly the history of Todd's career. Some of the material in this chapter must therefore inescapably duplicate what I have already written in my memorial to Todd (Parkes 1970), and I have paraphrased some sections of that article here.

BACKGROUND HISTORY ON THE MUSEUM

Andrew Carnegie's original gift to the City of Pittsburgh, offered in 1890, was for a library that would also include space for an art gallery, museum, and music hall. In 1891 the Carnegie Library trustees were authorized by the Pittsburgh City Council to erect a building on 19 acres of land recently acquired by the city from Mrs. Mary E. Schenley. The building was dedicated on 5 November 1895 as the Carnegie Library of Pittsburgh, which included space devoted to art and natural history as well as a music hall. In 1896 Carnegie fulfilled his promise, made at the dedication of the Library building, to endow what were then called the Department of Fine Arts and the Department of the Museum. These were administered by a new board of trustees (overlapping with those of the Library) under the name Carnegie Institute. The popularity of the Library and the need for additional space for the Institute led Carnegie to offer to build a major addition to the original building to include large galleries for the collections of art and natural history. The dedication of the expanded Carnegie Institute took place in April 1907, and the Library and Institute occupied premises in the 1895 building, as expanded in 1907, until 1974, when most of the renamed Museum of Art of Carnegie Institute moved into a new wing, the Sarah Scaife Gallery. Although much of the area thus vacated in the 1907 building was then taken over by Carnegie Museum of Natural History, there was little gain in space for the collections, the offices and laboratories. All of the scientific and education areas were dangerously overcrowded, but this condition was relieved in 1979, when the trustees bought and rehabilitated a building about two miles east of the Museum, in which the Sections of Anthropology and Mammals and the museum's collection of wildlife art are now housed. In 1992 this annex was formally named the Edward O'Neil Research Center, honoring a long-time friend and supporter of the Museum who had generously endowed field funds for all of the Sections.

A word on nomenclature is in order. As indicated above, the combined art and natural history museums were long known simply as "Carnegie Museum." The preferred acronym for the citation of Carnegie specimens, CM, dates to this period. When the name was officially changed to "Carnegie Museum of Natural History" in 1973, the CM

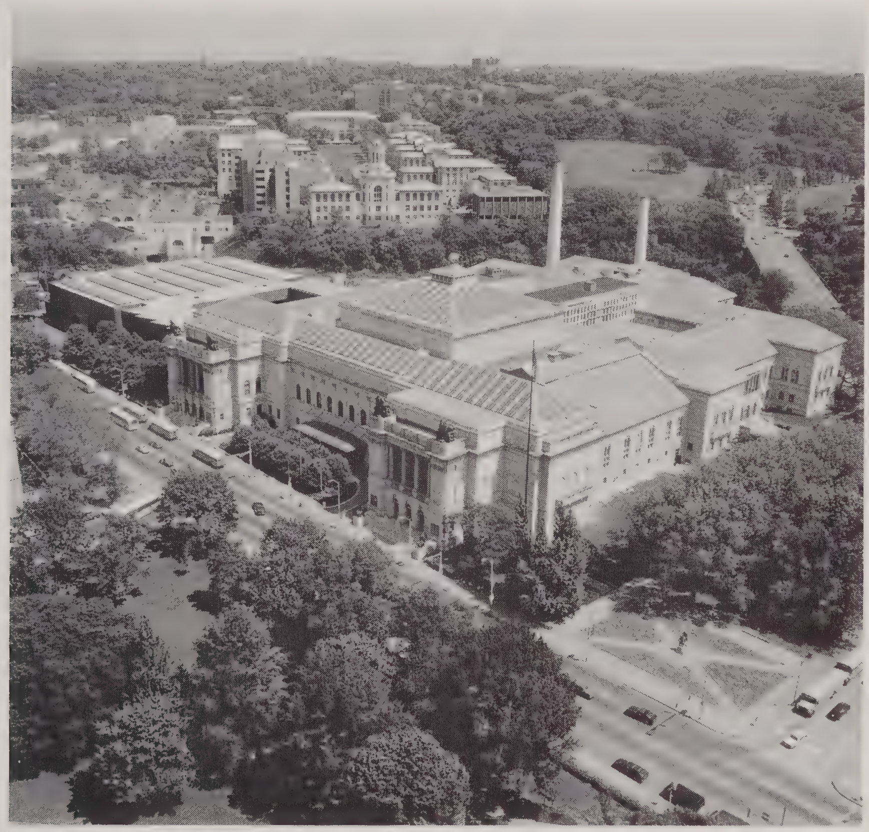

Fig. 1. The Carnegie complex in Pittsburgh, including the Sarah Scaife Gallery of the Museum of Art (far left), Museum of Natural History (central portion), Music Hall (lower right entrance), and Carnegie Library (right side).

acronym was retained, because "CMNH" could signify the Cleveland or Cincinnati Museum of Natural History. In the 1980s, as a public relations move, the entire museum/library/music hall complex was renamed "The Carnegie." Officially we are now The Carnegie Museum of Natural History, but in practice we omit the "The" as often as not. The subsidiary units of the Museum of Natural History, called Departments in most museums and Divisions in the U.S. National Museum of Natural History, are called "Sections" at Carnegie. In the early 1950s, the trustees appointed a Director with no scientific background, who felt that the public could not understand the long Greek-based names of the scientific disciplines. The Section of Ornithology thus became the Section of Birds, the Section of

Herpetology became the Section of Amphibians and Reptiles, etc. Although that Director had a short tenure, his nomenclature of the Sections persists to this day.

THE TODD YEARS

During the early 1890s, Todd was working in Washington for the Division of Economic Ornithology and Mammalogy of the U.S. Department of Agriculture, the predecessor of the Bureau of Biological Survey (which eventually became the Fish and Wildlife Service of the Department of the Interior). Todd contracted a severe case of malaria in 1896, and was permitted to go home to Beaver under a new government policy of extended sick leave. During his illness and in his absence, what proved to be the last meeting of the Western Pennsylvania Ornithological Society (which had been founded, with Todd as a member, in 1891) was held at the Carnegie Library in Pittsburgh. This was the first time that Todd had ever heard of this institution. He was discontented with government work in general, and felt that both his salary and his prospects for advancement were inadequate. Learning that the Carnegie Library in Pittsburgh was forming a "Museum Department," he took advantage of his Christmas week visit home to look over the new institution. The poor quality of most of the ornithological exhibits suggested to his ambitious young mind that the fledgling Carnegie Museum had an obvious need for a staff member with his own brand of expertise. To Todd's disappointment, the post he sought for himself was given to his friend Samuel Rhoads. Nevertheless, he offered his services as a freelance collector of birds and mammals for the 1898 field season in western Pennsylvania. This offer was accepted, and Todd subcontracted the mammals to Thaddeus Surber. Rhoads was unable to tolerate Carnegie Museum Director Holland's "dictatorial ways," and resigned, whereupon Todd reapplied for a position at Carnegie Museum, and was appointed as Assistant in Charge of Recent Vertebrates, at $50 per month, in April 1899.

In 1892 Todd had begun a survey of the breeding birds of western Pennsylvania, through a series of collecting trips during his vacations from his post in Washington. As a member of the Carnegie staff, he was not so restricted in his field time, and he continued to gather the data that culminated in his great book, *Birds of Western Pennsyvania* (Todd 1940). During his early years at Carnegie, he somehow became interested in the birds of northern Canada, and in 1901 the first of a series of 25 expeditions to Labrador and adjacent areas took place. A detailed list of these expeditions, with itineraries and personnel, can be found in the introductory pages of Todd's *Birds of the Labrador Peninsula and Adjacent Areas* (1963). Mr.

Todd's own final northern trip was the 23rd of this series; it took place in the summer of 1955, when he was just short of his 81st birthday. He described this as "more of a vacation trip, under *de luxe* conditions, than a serious undertaking, although it took me to some places I had not been before." He was a passenger on the Hudson's Bay Company's supply steamer "Rupertsland," and along the way he managed to find the opportunity to collect his last birds, four sparrows.

Todd's title changed several times in the early years. In 1900 he became Custodian of Recent Vertebrates, and in 1907 the post of Assistant Curator of Recent Vertebrates was created for him. The Custodian position remained, and was filled by Melvin A. Carriker, Jr., who had already begun what was to be a long career of collecting in the Neotropics. In 1909 the Custodian position was abolished, and Carriker was appointed Field Collector, Recent Vertebrates, a title more appropriate to his talents. This was narrowed to Field Collector, Ornithology in 1916. Others who have held the title Field Collector include Jose Steinbach (Recent Vertebrates 1910–1915; Ornithology 1916, 1920–1924) and Samuel Klages (Ornithology 1916–1924), both of whom made major collections in the Neotropics for the Carnegie Museum. Beginning in 1920, this was no longer a salaried position, the collectors being paid under contract for specific numbers of bird specimens.

Meanwhile Todd had been promoted from Assistant Curator to Curator of Recent Vertebrates in 1912, a title which was narrowed to Curator of Ornithology in 1914. In 1919 Todd got his first full-time Assistant Curator, a young ornithologist named George Miksch Sutton, who had worked briefly as a part-time assistant in 1918. Sutton remained on the staff until 1924, participating in collecting expeditions in Labrador, the James Bay region, and Florida—an exciting time for a young man in his mid-20s. Several chapters in Sutton's autobiography *Bird Student* (1980) recall those years in great detail. In 1924 he was offered and accepted the position of Pennsylvania State Ornithologist, and moved to Harrisburg. Nevertheless he maintained contact with Mr. Todd, and was permitted by the authorities of the Pennsylvania Game Commission, his employers, to take leaves in order to participate in several more Carnegie expeditions. In 1929 he began making arrangements to spend a year living on arctic Southampton Island, in northern Hudson Bay, beginning in 1930. His collections were purchased by Carnegie Museum, and the Cornell University Ph.D. thesis based on his expedition was published in the now-extinct series, Memoirs of Carnegie Museum (Sutton 1932). In Sutton's words, "So cooperative were the Carnegie Museum's editors that I was able to submit to the graduate college at Cornell three copies of the published paper rather than three copies of typescript" (Sutton 1980).

Other young men who served for a few years each as Assistants or Assistant Curators included Ernest G. Holt (Assistant 1924–1927; Assistant Curator 1927–1931), M. Graham Netting (Student Assistant 1922–1924; Assistant in Ornithology, Herpetology, and Ichthyology 1924–1926; later Curator of Herpetology and then, in 1953, Director of Carnegie Museum of Natural History), and Rudyerd Boulton (Student Assistant 1922–1924; Assistant 1924–1926; Assistant Curator 1926–1931).

In those early days it was not necessary to have a Ph.D. or other advanced degree to qualify for a curatorial title; in fact, Mr. Todd himself had less than a year of college. This policy is best illustrated by the career of Ruth Trimble, who was appointed as Secretary to Mr. Todd in 1927. Her services were invaluable, and it became apparent that she was capable of holding responsibilities well beyond those usually assigned to a secretary. Therefore, after Assistant Curator Boulton left in 1931, Trimble was promoted the following year to the position of Acting Assistant Curator, and the word Acting was dropped from her title in 1934. She remained in this position until 1940, meanwhile writing several scientific papers as well as some of the species accounts in Todd's *Birds of Western Pennsylvania* (1940). Trimble left to marry James Chapin, the American Museum of Natural History's expert on African birds. Mr. Todd, who allegedly had more than an employer's feelings for Ruth, did not forgive Dr. Chapin for many years, especially (reflecting Todd's Victorian upbringing) because Chapin was a divorced man.

Through all of these years, coincident with the field work in Canada, specimens had been arriving in Pittsburgh from the Neotropics, from Klages, Carriker, the Steinbachs (father and son), and various other collectors. Although Todd never visited the tropics, having been advised by his physician to avoid them after the bout with malaria in Washington, his interest in, and impact on, the study of Neotropical birds rivalled his devotion to the North Country. His most significant publication on Neotropical birds was *The Birds of the Santa Marta Region of Colombia* (Todd and Carriker 1922), a book for which the authors were awarded the Brewster Medal, the highest honor of the American Ornithologists' Union (AOU). Most of Todd's early publications on Neotropical birds were, like that on Santa Marta, avifaunal, but in later years while he was working on his Pennsylvania and Labrador books, he published numerous shorter papers as taxonomic revisions. Bibliographies of Todd's publications can be found in Trimble (1940) and Parkes (1970).

Todd was a very private person (as exemplified by his failure to inform his colleagues at the museum about his marriage in 1907). He detested telephone calls, and it took me several years after my arrival at the museum to convince the media that they could get a cordial and accurate reponse to bird questions over the telephone. Although "nothing in

Mr. Todd's secular life was as important to him as his association with the American Ornithologists' Union" (Parkes 1970), and he faithfully attended its annual meetings, he never took part in any of the Union's activities such as committee memberships, with the sole exception of hosting the AOU meetings in Pittsburgh in 1924 and 1937. He became a Fellow of the Union in 1916, and by action of the Council was elected Fellow Emeritus in 1968.

THE TRANSITION YEARS

In 1936, Arthur C. Twomey, a Canadian who had worked his way through college in part by collecting tundra birds and eggs for several museums, was appointed Assistant and Field Collector. He retained the title of Assistant until Trimble left in 1940, whereupon he took over the Assistant Curator position while retaining that of Field Collector. When Mr. Todd assumed Emeritus status in 1945, Twomey was promoted to Associate Curator, and to Curator a year later. A reorganization of the Carnegie Institute in 1948 resulted in Twomey's appointment to the newly formed Division of Education, which served both the art and natural history museums, while retaining his curatorship in ornithology. Twomey's work load in education apparently precluded his accomplishing any of the routine curatorial duties in the Section of Birds, so that Mr. Todd in his retirement continued to do all of the routine work such as cataloguing, packing and shipping loans, arranging exchanges, etc., when he was supposed to be devoting full time to the manuscript of his *magnum opus* on the birds of Labrador. This awkward situation was partly remedied by the appointment, in 1949, of an enthusiastic University of Pittsburgh undergraduate, Stuart Evans, as a part-time Assistant, to take care of routine matters like packing and shipping. However, Stuart graduated in 1952, and left the museum about a year later.

In 1947, Roland Hawkins, a Canadian protégé of Twomey's, was appointed Assistant in Preparation and later Preparator, and accompanied Twomey on some of his collecting expeditions to Honduras. Twomey wanted to advance Hawkins to the Assistant Curatorship, vacant since his own promotion in 1945. Todd was strongly against this move, realizing that Hawkins' qualifications for the post were minimal, and by the 1950s it was generally expected that newly appointed members of the curatorial staff would have advanced degrees. In 1952 Hawkins left to become the first director of the Pittsburgh Aviary. Attendees at the 1989 meeting of the AOU will remember the highly successful reception at the Aviary.

Twomey's background as a field collector influenced his career as a Curator in that he managed to arrange major expeditions, including several to Honduras, almost every year. However, once his Honduras specimens reached Pittsburgh, they languished in storage cases, unstudied and inaccessible to other workers, toward the day when Twomey was allegedly to write the definitive work on the birds of Honduras.

Some of the people who had contributed to the support of the expeditions on which Todd's Labrador studies were based became concerned that he was not making the expected progress on his manuscript because of the necessity of carrying on all of the routine work of the Section of Birds, which Twomey, nominally the Curator, completely neglected. The Museum's trustees, therefore, authorized the appointment of an Assistant Curator, so that for the first time since Todd's retirement there would be two professional curators on the staff of the Section of Birds. Todd's first choice for the position was Karl Haller, best known to the ornithological community as the discoverer of Sutton's Warbler (*Dendroica potomac*) now believed to represent hybrids between the Yellow-throated Warbler (*D. dominica*) and the Northern Parula (*Parula americana*). Haller, however, opted instead for a career as an Air Force officer, but manifested his continued interest in the museum by donating his collection of West Virginia birds, and later sending specimens collected near his various military posts.

THE PARKES YEARS

I had met Mr. Todd at the 1947 AOU meeting in Toronto, my first, and I had corresponded with him in my capacity as the graduate student curator in charge of the Cornell University bird collection. He suggested and then supported my candidacy for the Carnegie position. I was interviewed in August 1952, immediately after my Ph.D. defense, and was informed about two weeks later that I would have the job as soon as they found funds for it. I managed to support myself until February 1953, when I was told that I should report to the Carnegie on 1 March. I was so irritated at having been kept in limbo for so long that I opted to stay in Ithaca through 3 March, primarily because there was a good party on 1 March that I didn't want to miss. I reported on 4 March; that date was responsible for my suffering Mr. Todd's greatest feat of one-upmanship. On 4 March 1963, I asked Mr. Todd if he knew the significance of the date. He wasn't sure what I meant, so I said "Mr. Todd, exactly ten years ago today I started working for Carnegie Museum." Mr. Todd said a couple of politely complimentary things, and then, after thinking for a moment, said "Exactly 66 years ago today, I stood in the front row and watched the inauguration of President William McKinley."

My acceptance of the Assistant Curatorship had been contingent on my agreeing to complete Mr. Todd's Labrador manuscript should he not live long enough to do so (he was then in his 80th year). Not knowing anything about Arctic birds, I was blessed by Mr. Todd's longevity; *The Birds of the Labrador Peninsula* was published in 1963.

Stuart Evans departed a few months after my arrival in Pittsburgh, so that with Twomey's time being devoted to other matters, the functional staff of the Section of Birds consisted of Mr. Todd as Curator Emeritus, a part-time secretary who typed Todd's manuscript and correspondence, and myself as Assistant Curator in Charge of "Everything Else." The operating budget of the Section at that time, exclusive of salaries, was so small that I saved the brown paper in which the laundry wrapped my shirts to use on outgoing packages of birds, as new brown paper cost a penny a sheet. We were hopelessly crowded. All three of us had desks in the aisles of the bird range. Todd's and mine were at the ends of aisles where there was a little space, but the Carnegie's was no doubt the only bird collection at which one had to move the secretary out of the way in order to examine specimens of Caprimulgidae.

In 1956 I was invited by William Hammon of the Graduate School of Public Health, University of Pittsburgh, to take part in an expedition to Luzon, Philippine Islands. Hammon, who had discovered the pre-Salk vaccine, gamma globulin, treatment for polio, had been asked by the U.S. Office of the Surgeon General and the Philippine Government to form a team to study a viral disease of unknown origin, but presumably arthropod-borne, affecting Filipinos (especially children) in the vicinity of Manila and potentially the American troops and their families stationed nearby. In addition to Hammon, the team included two medical entomologists, a pediatrician, and a mammalogist and ornithologist to sample the local fauna in search of alternate hosts of the virus. Netting, by then Director of Carnegie Museum, agreed to lend me to the University on the assumption that I would bring bird specimens back to Pittsburgh. Canuto G. Manuel, then the ornithologist at the National Museum of the Philippines, assigned the experienced collector and preparator Telesforo Oane as my assistant, and we made a small but significant collection of birds of central Luzon. For many Philippine bird species, Manila is the original or restricted type locality, but in most of the 20th century, museums have concentrated on getting collections from outlying islands and from mountains in the larger islands. As a result, *modern* topotypical specimens of common lowland birds from Luzon were rare in museum collections. In studying my birds, I came to the conclusion that there was room for another "expert" on Philippine birds, and embarked on a research program that eventually culminated in the publication of *The Birds of the Philippines* (Dickinson et al. 1991).

In the 1960s I was able to participate in collecting expeditions to northeastern Argentina (with P. S. Humphrey and W. H. Partridge) and several areas of Mexico (with A. R. Phillips and R. W. Dickerman, and later with J. W. Hardy), filling in geographic and taxonomic gaps in the Carnegie Museum's rich Neotropical collections.

Twomey retained the title of Curator through 1961, but in 1962 a reorganization of the Section saw my promotion to Curator with full jurisdiction over all of the collections (including Twomey's), and his relegation to an honorary position in the Section, which he held until his retirement in 1973.

Most of the scientific sections of the Museum had been badly understaffed, especially considering the international importance of their collections, and the Section of Birds was certainly no exception. For several years in the 1960s, therefore, an Assistant Curator was appointed annually to alleviate this problem, section by section. In 1963, at my recommendation, we hired Mary A. Heimerdinger, who was finishing her Ph.D. at Yale, where she had gained curatorial experience at the Peabody Museum of Natural History. Heimerdinger was soon given two major responsibilities. One was the supervision of the newly-established bird-banding program. Heimerdinger's Ph.D. dissertation had concerned the long-neglected study of pterylosis, the geometrical arrangement of the feather tracts of birds, variations in which had proved to have taxonomic significance. I therefore asked her to take responsibility for the small but growing anatomical collections of birds, both skeletal and alcoholic. She quickly became well-known and respected in both the bird-banding and avian anatomical communities.

As mentioned earlier, Mr. Todd's Labrador book was published in 1963. In that same year he became seriously ill, a condition that Dr. Heimerdinger characterized as the most devastating case on record of "post-thesis letdown." Early in 1965 Todd began to ask us to bring to the hospital certain books and journals (Parkes 1970). His week-to-week improvement was obvious, and we wondered what had brought it about. Finally he confided that he had hit upon a goal. He remembered that in 1890, the year he had joined the AOU, President J. A. Allen had given an address entitled "The American Ornithologists' Union—a seven years' retrospect." Todd had decided that he wanted to attend the 1965 AOU meeting in Columbus, and that he would offer a paper entitled "The American Ornithologists' Union—a *seventy* years' retrospect." Todd did attend, and presented at the banquet half an hour of reminiscences of the early days of the AOU and of the Biological Survey, read without eyeglasses from his handwritten manuscript. He received a thundering standing ovation. Two years later, at the AOU meeting in Toronto, the last he ever attended, Todd became the first and only recipient in AOU history of a second Brewster Medal, this time for the Labrador book.

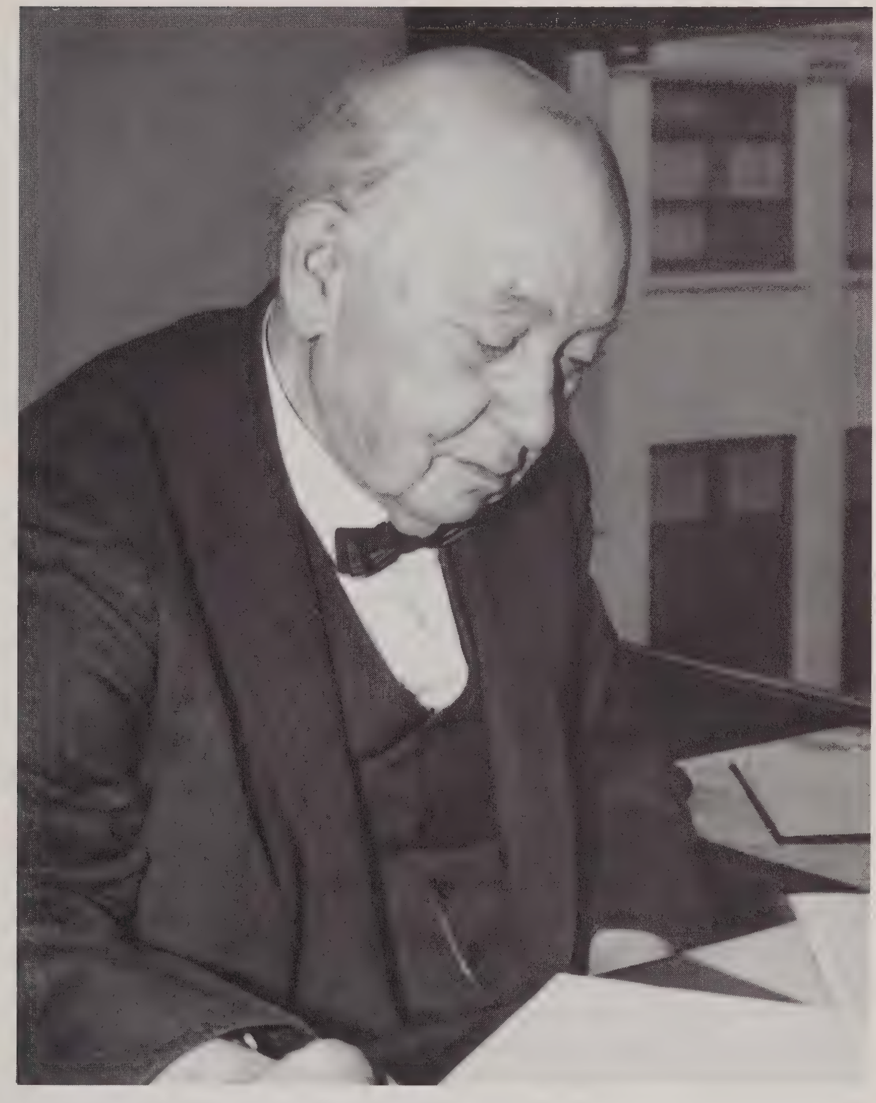

Fig. 2. W. E. Clyde Todd, Curator Emeritus of Birds, Carnegie Museum, in his 86th year, 13 February 1961.

Some years earlier, the heirs of Herbert Brandt of Cleveland had donated Brandt's egg collection to Carnegie Museum, doubling the size of our egg collection from about 5000 to about 10,000 sets. Todd had begun his career during the heyday of egg collecting, and retained an interest in eggs that was utterly without counterpart in either Heimerdinger or me. In 1957 he had been appointed Honorary Curator of Birds' Eggs, and after his recovery from his near-fatal illness, he spent his time cataloging the Brandt egg collection. This was a major undertaking, as the egg data were written on all sorts of heterogeneous slips of paper and in tiny notebooks, all of which arrived in Pittsburgh piled helter-skelter into boxes. Todd died in 1969, in his 95th year, without finishing the herculean job of making sense of the Brandt collection, the cataloging of which was not completed until years later.

Because of a death in her family, Heimerdinger was granted a year's leave of absence beginning 1 June 1967. In December 1967, she was married to Harry K. Clench, the Museum's lepidopterist. Shortly after her return in 1968, she was promoted to Associate Curator.

Both Mary Clench and I have been active in the ornithological societies, unlike Todd. I served as President of the Wilson Ornithological Society in 1974–1975, and Clench followed suit in 1988–1989 after she had left Carnegie. For the AOU, my longest committee tenure was on the Committee on Classification and Nomenclature, on which I served for the 17 years prior to the publication of the 6th edition (1983) of the AOU *Check-list of North American Birds.* I have also served on the By-laws, Brewster Award, Scientific Program, and other AOU Committees, and co-hosted the 1989 Pittsburgh AOU meeting with Robert J. Raikow of the University of Pittsburgh. Although Carnegie Museum of Natural History is not a teaching institution, both Clench and I served on advisory committees for graduate students in ornithology at the University of Pittsburgh.

Although professional-level staffing at Carnegie had improved since the addition of Clench and other Assistant Curators, several sections, including Birds, had little or no subcuratorial help. This was partly alleviated through a work-study arrangement with Chatham College, Pittsburgh's fine liberal-arts women's college whose most famous alumna is probably Rachel Carson. However, the available funding sufficed only to allow one Chatham student to work for the Section of Birds two afternoons a week. We were particularly lucky, however, as we were assigned the only sophomore in the Chatham group, Vera Berkowitz, who was thus with us for three years, whereas most of the sections had to train a new student every year. Berkowitz set up a number of filing systems that are in use to this day.

The growing need for subcuratorial help in the Section was exacerbated when the Chatham College program was terminated. I therefore applied, successfully, to the National Science Foundation's (NSF) program for the support of systematic collections for a five-year grant intended primarily to provide salary for a Curatorial Assistant, a title unrepresented in any section at that time. The appointment went to Miriam Stern, who had just graduated from Cornell and had had curatorial experience, although primarily in herpetology. Her felicitous addition to our staff was, in a way, contagious, and several other sections solicited our help in drafting grant proposals, "so we can get our own Miriam." Stern resigned in May 1977 to get married, and her place was taken by James (Jay) M. Loughlin, who came to us from the Manomet Bird Observatory. Loughlin's accomplishments went well beyond those usually expected of a Curatorial Assistant. He was transferred from the NSF-funded positon to the permanent staff when the grant expired, and in 1981 received the well-deserved promotion to Collection Manager.

In 1978 Joseph R. Jehl Jr. and I led the first of two expeditions (the second took place in 1981) to the Islas Revillagigedo, Mexico, in the Pacific Ocean southwest of Baja California. We discovered that the avifauna had been drastically altered since the last visit by an ornithologist 20 years earlier, one endemic species having become extinct and another in jeopardy. We attributed these changes to the introduction of domestic (now feral) cats, and published two papers on our studies of the avifauna of the archipelago as they influenced theories of island biogeography.

In 1979 Mary Clench's husband Harry died unexpectedly, and she suffered a series of small strokes. Under the circumstances she felt it best to resign from the Carnegie Museum in 1980, to join her family in Gainesville, Florida. She was quickly appointed as a Research Associate in the Section, and has subsequently maintained a close connection with the Section's staff.

In 1981 D. Scott Wood, who was finishing his Ph.D. at the University of Oklahoma, was appointed to succeed Clench. His M.S. thesis and Ph.D. dissertation were phenetic studies of the cranes and storks based on osteology, and he had had considerable bird-banding experience, so he was a natural choice to take over Clench's responsibilities for the anatomical collections and the bird-banding program. Furthermore, he was thoroughly acquainted with current progress in data processing, notably the computerized cataloging of specimen collections. Wood was primarily responsible for drafting two successive NSF grant proposals, whereby we received funds for installing a state-of-the-art compactor system for housing specimens. This system increased our storage capacity by two-thirds but occupies only three-quarters of the floor space formerly devoted to specimen cases. The grants also supported the continued computerization of collection records and data checking, and a salary for Robin K. Panza, formerly of the University of California at Santa Barbara, as Curatorial Assistant. Panza quickly demonstrated her versatility (among other talents, she is a skilled illustrator), but was necessarily restricted to working under the constraints of the job description specified in the NSF proposal. In 1992 she was transferred to the permanent staff, and has broadened her activities to include original research. Jay Loughlin resigned as Collection Manager early in 1994 to move to Arizona, and Panza was promoted to that position. Funding was not made available to hire a new Curatorial Assistant, so it became necessary to parcel out responsibilities among a diminished staff.

Wood took a great interest in the Museum's excellent ornithological library. We had already received part or all of two private collections of ornithological publications, and Wood was influential in obtaining two more such collections. Unfortunately Wood found it necessary to resign from the Carnegie in 1992 for personal reasons.

During my early years, if bird specimens arrived at the museum in the flesh (such as those donated by the zoo or aviary), I had a choice of preparing them myself or filling out a work order to have them prepared by one of a succession of taxidermists who were members of the Section of Exhibits. Later, we obtained funds for a part-time scientific preparator for birds. When a full-time preparator was added to the staff, the Section shared his or her time with either mammalogy, herpetology, or both. The incumbent, Stephen P. Rogers, who works 60% for us and 40% for herpetology, is not only a skilled preparator, but a student of the history of taxidermy, about which he has assembled an important library.

In November 1993, Bradley C. Livezey of the University of Kansas, best known for his studies of steamer-ducks with P. S. Humphrey, was appointed Associate Curator of Birds to replace Wood. His research program includes phylogenetic analyses of waterfowl and Gruiformes. Like Clench and Wood, he has assumed oversight responsibility for the bird-banding program and the anatomical collections.

THE COLLECTIONS

Although I have mentioned a few areas from which we have received specimens, I have not yet summarized our principal strengths. At this writing, the gross number of bird skins in the collection is over 170,000, but somewhat over 16,000 of these have been dispersed from the collection through exchanges, gifts, transfers to the Museum's educational loan collection, or discard. Including specimens awaiting cataloging, there are over 14,500 skeletons, 6500 alcoholic specimens, and 10,220 egg sets. Wood initiated the practice of cleaning only one wing when skeletonizing a specimen, keeping the other as a flat spread wing, sometimes accompanied by the tail. Such specimens are superior to traditional study skins for the study of molt, and are a revelation to bird artists wanting to paint or carve birds in a flying position. The Section has maintained a close relationship with bird painters and carvers, and I have served as a judge for numerous competitions, including the 1993 Federal Duck Stamp Design competition and the Ward Foundation Wildfowl Carving Competitions.

The largest single accession in the history of the Section of Birds was the private collection of A. W. Anthony, almost 10,000 specimens, received in 1904. Its geographic strengths are the western United States and Baja California (including the adjacent islands), with a scattering of birds from other states and countries.

From North America, in addition to Mr. Todd's material from northeastern Canada, we have major collections from the Northwest Territories, British Columbia, Alberta, Saskatchewan, and Manitoba (mostly from the Churchill area), and from parts of Oregon, California, Idaho, Utah, Arizona, New Mexico, Texas, Oklahoma, Michigan, Florida, Virginia, Maryland, West Virginia, Ohio, Pennsylvania (mostly western), New York, and Massachusetts. Neotropical countries best represented in our collections, to the extent that revisionary or distributional studies are incomplete without reference to our specimens, include the Bahamas, the Isle of Pines (now the Isle of Youth, Cuba), Mexico, Belize, Honduras, Costa Rica, Colombia, Venezuela (with some specimens from adjacent Trinidad and Curaçao), French Guiana, Amazonian Brazil, Bolivia, and northern Argentina. We have smaller but significant collections from Puerto Rico, Panama, and Chile. Our representative specimens from other West Indian islands, Ecuador, Peru, Brazil outside of Amazonia, and elsewhere in Latin America, have been obtained chiefly through small exchanges.

From the Old World, our collections are spotty. We have large and important older collections from Cameroon and Angola, and a smaller but valuable collection from Zimbabwe. In the 1960s Twomey organized several expeditions to Africa. In the first of these, to Kenya, Tanzania, and western Uganda in 1960, he obtained the services of John Williams, author of the standard East African field guide, and the specimens are fully documented as to gonad size, soft part colors, stomach contents, etc. This large collection, studied principally by Stuart Keith of the American Museum of Natural History, yielded several new taxa and important range extensions, particularly in the Uganda forests. For the next expedition, in 1963, confined to Kenya, Alec Forbes-Watson accompanied Twomey, and the labeling closely matches John Williams' standards. In 1964, relying principally on local field assistants, Twomey collected in Mozambique, Botswana, and again in Kenya. Specimens from these collections are less thoroughly labeled.

Our major European collection is from Austria and components of the former Yugoslavia. One of the earliest major accessions was a 19th century collection of 748 mounted birds from the Netherlands; many of these have been discarded, but others were converted into study skins. The relatively small European component of the Anthony collection is principally from Sweden, but these are important as being topotypes of numerous Linnaean species. We have just a scattering of birds from other European countries.

Todd had obtained, by purchase from the National Museum of the Philippines, representative collections from the islands of Luzon and Palawan. After my visit to Luzon in 1956, I began accumulating more Philippine birds through purchase and exchange. Other Asian countries represented by small collections include Japan and China. Virtually all of our specimens from the Indian subcontinent and the East Indies have been obtained through small exchanges. We have a small but historically interesting collection obtained by the Denton brothers in Papua New Guinea, northern Queensland, and Victoria, Australia, and obtained through purchase the third and smallest collection of New Zealand birds made by Lord Buller in the late 19th century. Label data are often minimal, but the collection includes a number of extinct and endangered forms (see Buller 1905:167).

Todd published a list, with minimal annotation, of the primary types in the Carnegie collection as of 1 May 1928 (Todd 1928). There were 289 at that time, of which Todd had described 240. The list has grown to 554 at this writing. It is our hope to publish a type catalogue, more critically annotated than that of Todd, in the near future.

THE BIRD BANDING PROGRAM, PUBLICATIONS, AND FINAL REMARKS

In 1956, the Museum acquired its field station, Powdermill Nature Reserve, in the Ligonier Valley of Westmoreland County about 50 miles east of Pittsburgh. In the course of planning staff activities for the Reserve, Netting suggested that we might inaugurate a bird-banding program. A short pilot project in the late summer of 1960 appeared promising, so the following year we hired Robert C. Leberman, a young but experienced bander from Meadville, Pennsylvania, to run the program. At first it was operated only between March and November, as the only house on the property available for Leberman's use was not winterized. He returned to Meadville for the winter, and was on the Museum's payroll for an additional month to work on the required reports. Midwinter banding was confined to an occasional weekend, chiefly by A. C. (Bert) Lloyd, a member of the Museum's maintenance staff who was also an experienced bird collector and bander.

Fig. 3. Kenneth C. Parkes, Curator of Birds. Photograph taken at Donegal Lake, near the Museum's Powdermill Nature Reserve, on the occasion of a visit of a "Bewick's" Swan (Tundra Swan *Cygnus columbianus bewickii*).

The success of the banding program was such that Leberman was invited to design his own winterized house to be built on the Powdermill property so that banding might go on throughout the year (except for brief periods in midsummer and midwinter, when he took his vacation). We were still somewhat handicapped, as we wanted as much continuity as possible in order make year-to-year banding results comparable. As Leberman's reputation grew in the banding community, he received invitations to speak at meetings, and was invited to participate as a bander on a Manomet Bird Observatory field trip to Belize. The dilemma created by Leberman's absences was solved by the appointment in 1983 of a second bander, Robert S. Mulvihill, who had previously worked at Powdermill as a volunteer banding assistant. His position has been supported by a generous annual grant from the Laurel Foundation, and his banding experience has led him into several fields of research.

The records kept in Pittsburgh, originally on file cards for each individual bird, became one of the first databases in the Museum to be computerized, and is still one of the largest. The records and reports were handled for years by a series of short-term volunteers and part-time workers. In 1984 Marilyn E. Niedermeier took over this position, through the major transition from pencil and paper to computer disk. Powdermill is now the largest inland bird banding station in North America, operating the year around rather than only during migration periods. An average of about 10,000 birds, mostly land birds, are banded each year. Numerous publications have been engendered by the program, which is probably the only one in North America operated by a major museum. Thanks to the full computerization of the records, our banding data are available to any researcher.

The staff of the Section of Birds has always realized the importance of communicating their knowledge by publishing research papers, popular articles, reviews, etc. The Annual Report of Carnegie Museum began listing staff publications in 1954. From that year through 1992, members of the Section of Birds (excluding Research Associates) were authors or coauthors of 253 research papers, 82 popular articles, 111 book reviews, 39 books, book chapters, or encyclopedia entries, 16 bibliographies, 5 obituaries, 7 specimen inventories, and 49 bird-banding reports.

International emphases in ornithological research have changed dramatically during the years of my professional career, more than 40 of which have been spent at Carnegie Museum of Natural History. This is particularly true of most of the recent research in systematics, at least in North America. Laboratory facilities for limited studies at molecular levels are already in place at Carnegie Museum of Natural History, and will probably be expanded in the near future, but the museum will probably not have the finances to install laboratories appropriate to such rapidly evolving "cutting edge" techniques of avian systematics as DNA studies. I must hope that ornithological research at the Carnegie Museum of Natural History, with one of the best bird collections in North America, will continue to be centered in large part on the kinds of studies that can only be conducted with traditional skin and anatomical specimens, research that has been all but abandoned at several institutions with even larger specimen resources than ours.

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8

Ornithology at the Museum of Vertebrate Zoology, University of California, Berkeley

Ned K. Johnson[1]

Abstract.—I present an overview of eight decades of ornithological activity at the Museum of Vertebrate Zoology, starting in 1908 with the first Director, Joseph Grinnell. Through careful studies of single species, conducted in the field and documented with properly labelled specimens, Grinnell rescued natural history observations of birds from their anecdotal trappings. Through his most prolific student, Alden H. Miller, Grinnell established an academic genealogy that is arguably one of the strongest in the history of ornithology. The concepts of competitive exclusion, the niche, the guild, and some of the deepest roots of avian behavioral ecology can be traced to Grinnell and his intellectual descendants. High standards of field and museum-based research, the essence of the Grinnellian tradition, also have led to a wealth of dependable baseline avifaunal data and to a series of exceptionally detailed monographs in avian systematics. Continuing avian investigations at the MVZ concentrate on evolutionary genetics, biosystematics, distribution, and behavioral ecology.

> *"We do not want to depend on museum-bound theorists and interpreters who are not in touch with the living organism in its natural setting. Ornithology is a field science in large measure and much of its strength . . . lies in this fact."* (A. H. Miller 1955:19)

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The legion of ornithologists associated with the Museum of Vertebrate Zoology (MVZ) over the eight decades of its existence has left a rich history of accomplishment. I restrict my essay to: (a) comments on the environment of the MVZ on the Berkeley campus, with a short review of ornithology in the Departments of Zoology and Integrative Biology, (b) a synopsis of Joseph Grinnell's academic genealogy in ornithology, (c) a brief review of what has come to be known as the "Grinnellian philosophy," with remarks on some of its more intangible properties, (d) a cursory assessment of the MVZ's contribution to the growth of ornithology through its principal publications, and (e) in Appendix I, biographical snippets of the principal figures. Perusal of this material will reveal that the abundant record of ornithological activity at the MVZ justifies future analysis at a depth not possible here.

THE ENVIRONMENT OF THE MUSEUM OF VERTEBRATE ZOOLOGY ON THE BERKELEY CAMPUS

Since its inception, the MVZ has been affiliated with a major academic unit (the Department of Zoology, until 1988 and, from 1988-present, the Department of Integrative Biology) at the University of California, Berkeley. Eakin's (1956, 1988) detailed accounts cover the history of the Department of Zoology, including the growth of vertebrate zoology at the MVZ, since its founding. From the start, therefore, MVZ personnel were cast into the broader intellectual setting provided by an active company of scientists with interests other than vertebrates. Another advantage has been the presence of the University of California Press. Primarily through its Publications in Zoology series, this venerable institution has served as the principal outlet for the monographic research of the MVZ faculty and graduate students. The long association of the MVZ with the milieu and accouterments of a prominent research university has had enduring benefits.

In the early days, Museum personnel contributed minimally to department teaching programs and initially offered instruction only in vertebrate zoology and "economic zoology." Abundant time remained for field work (collecting), analysis of specimens, and writing. Time erased these Utopian circumstances. Today, all Museum faculty hold professorships, participate in the full range of University and public service obligations, and actively teach both undergraduate and graduate students. N. K. Johnson continues to teach the ornithology section of the course, Natural History of the Vertebrates (now Integrative Biology 104/104L [until 1988 it was called Zoology 107, 107L]), inherited from A. H. Miller who had, in turn, inherited it from J. Grinnell (when it was called Zoology 113).

Similarly, Johnson has perpetuated the course in advanced ornithology, which includes a laboratory on birds of the world and is patterned after a similar offering once taught by Miller. Johnson and Koenig also incorporate avian examples into their courses in biogeography and behavioral ecology, respectively.

In 1957, Peter Marler, an ethologist and expert in avian communication, came to Berkeley from Cambridge University and took a post in the Department of Zoology. Although not an official member of the MVZ, Marler and his cluster of excellent graduate students (Masakazu Konishi, Ph.D. 1963; James A. Mulligan, Ph.D. 1963; George L. Hersh, Ph.D. 1966; Fernando Nottebohm, Ph.D. 1966) interacted freely with students and faculty of the Museum. Marler introduced the audiospectrograph to our department. The objective demonstration that advertising songs differed among several difficult sibling species of small flycatchers (*Empidonax*), permitting these songs to serve as reproductive isolating mechanisms (Johnson 1963), was possible because Marler allowed my use of his audiospectrograph even though I was not a member of his group. Marler departed in 1966 to accept a position at Rockefeller University. Soon thereafter, I obtained grant funds for an audiospectrograph and associated instruments, enabling the establishment within MVZ of a modest facility for the analysis of bird vocalizations. Rarely, other faculty in the Department of Zoology have sponsored graduate students in ornithology. Robert Raikow (Raikow 1970), for example, was the doctoral student of Wilbur Quay.

JOSEPH GRINNELL'S ACADEMIC GENEALOGY IN ORNITHOLOGY

Grinnell guided a series of doctoral students in mammalogy and ornithology, especially in the last two decades of his career. Many of these students rose to prominent positions in vertebrate zoology and established fundamental intellectual lineages that survive to this day. For example, his most prolific student of mammalogy, E. Raymond Hall, supervised the Ph.D. research of 21 students, three of whom (J. S. Findley, D. F. Hoffmeister, and J. K. Jones, Jr.), in turn, produced a total of at least 53 systematic mammalogists (Jones 1991). Grinnell also sponsored the Ph.D. research of an exceptionally productive ornithologist, Alden H. Miller, who guided the doctoral research of 28 students in ornithology.

Following the example of Jones (1991), who traced Grinnell's professional genealogy in systematic mammalogy through E. R. Hall and his descendants, I document the exceptional intellectual lineage in ornithology established by Grinnell through Alden H. Miller (Fig. 1). (Based in part on this lineage, Pitelka [1993] has recently published a similar but more detailed family tree that also includes the academic "grandchildren" of A. H. Miller.) Two of Grinnell's doctoral students (J. M. Linsdale and A. H. Miller) spent their professional careers at the MVZ. Linsdale evidently sponsored no graduate students in his position as Resident Director, Hastings Natural History Reservation. Four of Miller's students, A. S. Leopold, F. A. Pitelka, J. Davis, and N. K. Johnson, also remained at the MVZ for their careers, although it should be noted that Leopold maintained a joint appointment with the Department of Forestry for a significant period and that Davis, like Linsdale, was off-campus at the Hastings Reservation.

Seven of Leopold's 11 students worked on quail, one on grouse, one on orientation in waterfowl, one on kestrels, and one studied responses of forest bird communities to management practices. Thus, emphasis on game species and applied problems is evident. All of Pitelka's 26 students have been ecologists and have examined a broad taxonomic representation of birds from an equally diverse set of research questions in both community and behavioral ecology. Of Davis' three doctoral students, one was basically a systematist at the time of his doctorate and the other two were ecologists. Eight of Johnson's 10 students have been, or are, systematists-evolutionary geneticists; two focused on ecological questions with systematic implications. At the Hastings Natural History Reservation, MVZ, Grinnell's academic "great-grandson," W. D. Koenig, has guided the doctoral research of three students, all of whom are behavioral ecologists. Five individuals from this lineage have been honored by election to the National Academy of Sciences: A. H. Miller, A. S. Leopold, C. G. Sibley, R. K. Selander, and G. H. Orians. Incomprehensibly, Grinnell was never elected to the Academy; according to Eakin (1988:13), Charles A. Kofoid, the imperious Chairman of the Department of Zoology at the time, would not support his nomination.

After earning Berkeley doctorates, many members of the Grinnellian dynasty migrated to other institutions where they hatched their own academic progeny. I would be seriously remiss not to mention the outstanding students sponsored by C. G. Sibley at Cornell and Yale; R. W. Storer at the University of Michigan; T. R. Howell at the University of California, Los Angeles; and R. F. Johnston at the University of Kansas, among others. It is not difficult to conclude that Grinnell's academic lineage is one of the strongest ever produced in American ornithology.

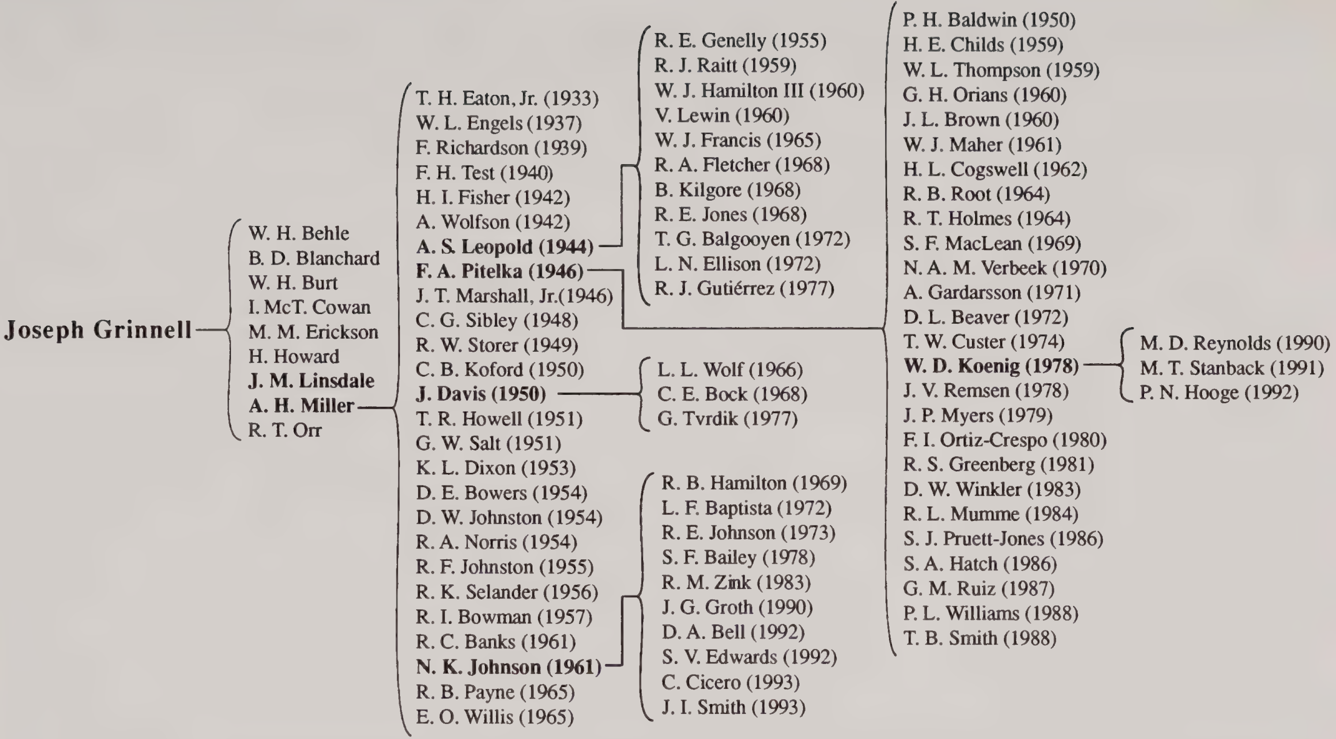

Fig. 1. Joseph Grinnell's academic genealogy in ornithology as traced through his most productive "son," Alden H. Miller. Year of doctorate in parentheses. Masters degree students are not included. Names of individuals associated with the MVZ for their entire careers are in boldface. One of Grinnell's academic "daughters," Hildegarde Howard, was unofficially "co-sponsored" by Prof. Loye H. Miller (of the University of California, Los Angeles), the biological father of Alden H. Miller.

THE GRINNELLIAN PHILOSOPHY AND TRADITION

When Joseph Grinnell was appointed the first Director of the MVZ he instituted a combination of practices and goals that became deeply embedded in the ethic of his students and associates and, eventually, became synonymous with the philosophy of the Museum as an institution. Many of these ideals were openly declared in his writings. Other components of his general viewpoint apparently went unrecorded and instead took the form of attitudes passed by tradition through his academic descendants. Here I attempt a brief analysis of the important ingredients of Grinnell's philosophy. Previously (Johnson 1971), I mentioned some of these points without elaboration.

Emphasis on field work.—Foremost in the Grinnellian tradition was the axiom that vertebrate animals had to be studied as free-living organisms in their natural environments. Instead of being regarded merely as a healthy preliminary in the investigation of ornithological problems, field work was deemed crucially indispensible. The photographs that punctuate this essay (Figs. 2-14) were specifically chosen to document this tradition.

Specimen collecting.—Furthermore, the most effective field work was viewed as that which transcended the purely observational. Specimen collecting had to be a vital part of any field endeavor. It not only provided vouchers for facts ascertained and objects for permanent careful study later in the museum, but also the act of collecting itself gave unique instruction. Grinnell (1915) clearly stated this premise:

> "It is to be doubted whether authoritative and expert systematic and field ornithologists can be developed through any other process than by personal collecting of adequate numbers of specimens in the field. The processes of hunting, and personal preparation of bird skins, bring a knowledge of the characters of birds, both in life and as pertaining to their structure and plumage, which can be secured in no other way."

The collecting program initiated by Grinnell and his associates continues to this day. The present MVZ holdings of birds are: skins and skeletons, 173,947; alcoholics, 3000; nests and eggs, 13,625; frozen tissue, 4000 vials; magnetic tapes of vocalizations, 250 master tapes. The avian collection emphasizes specimens from western North America, Middle America, and northwestern South America, but includes significant material taken worldwide. Notably, it includes an unusually high percentage of specimens with tags annotated with information on body mass and reproduc-

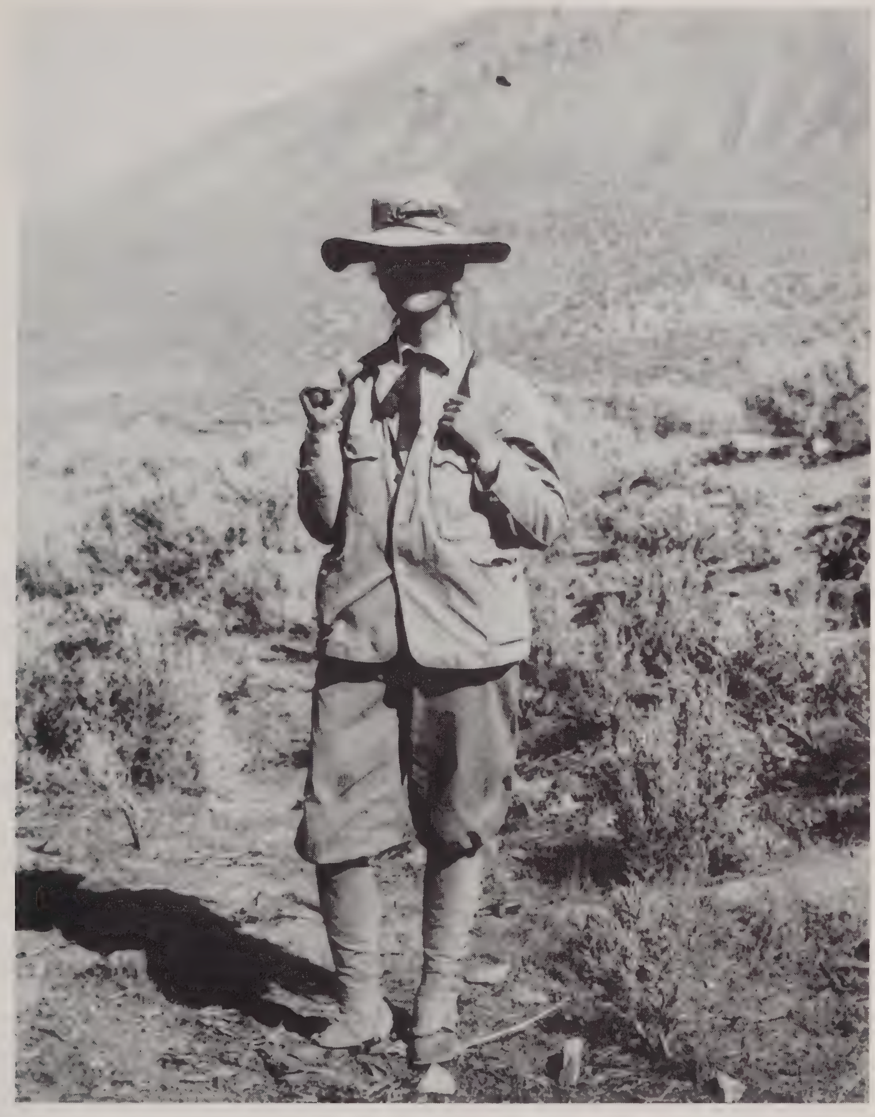

Fig. 2. Annie M. Alexander in field attire. Although the locality and date are uncertain, the rimrock topography and sagebrush scrub are typical of Humboldt County in northwestern Nevada where she hunted fossils and collected vertebrates in 1909 and 1910. On that trip much of her exploration was on horseback. On 10 May 1910 she wrote (MVZ field notes): "Rode from Alder Creek to Virgin Valley 25 miles. Pine Forest Range has a light fall of snow. . . . the ride today was made disagreeable by a cold north wind and occasional sleet. While riding through a sleet storm saw a large Red Tail Hawk [*Buteo jamaicensis*] quite near. We lunched at 'The Gorge'—a break in the lava wall 650 ft. high . . . "

tive condition. Furthermore, many near-species and species complexes illustrating speciation-variation problems are often represented by uncommonly long series of skins and skeletons with associated tapes of vocalizations and samples of frozen tissue.

Series of specimens from single sites.—The mere collection of a few specimens, however, was not enough. Instead, the ideal was to obtain *series* of specimens from a single locality or a group of sites located in close proximity. In promoting this goal, Grinnell and later, Alden Miller, were therefore among the first to appreciate the need to document the degree of biological variation so magnificently illustrated by large series of specimens of a given taxon from point localities and, by extension, its relevance to evolutionary processes and systematics. Such series, when compared with series from other localities across zones of climatic, topographic, and biotic change, provided the clearest possible evidence for the influence of environmental discontinuities (barriers) in molding geographic variation. Grinnell and Miller were thus leaders in population systematics, as Mayr (1973) has properly recognized. The need to distinguish intrapopulation from interpopulation variation on the basis of adequate material is a prime requirement in attempting to describe geographic variation. Failure to separate these two levels of variation because of insufficient samples has been, and continues to be, a major explanation for flawed systematic work on birds.

The importance of collecting by the researcher.—In the early period of avian systematics, most research and publication was conducted by museum-bound investigators with little or no direct field experience with the taxa they described. Their specimen material typically was gathered either by professional collectors or incidentally by workers whose main fields were not ornithology. As a result, their analyses and conclusions were of necessity devoid of any personal knowledge of the ecological setting in which the specimens were obtained or of information on behavior of the individuals studied. Research conducted at the MVZ, starting during the Grinnell era and continuing to the present, has exposed the serious weaknesses of this methodology.

The quality of natural history data.—A major component of the Grinnellian tradition relates to the accuracy and completeness of data. The last half of the 19th century had seen the publication of the great reports of government exploration parties and a plethora of other literature on the birds of the western United States (see Grinnell 1909 and 1924 for a nearly exhaustive annotated listing of these publications, specifically with reference to California). Although voluminous, this literature can be

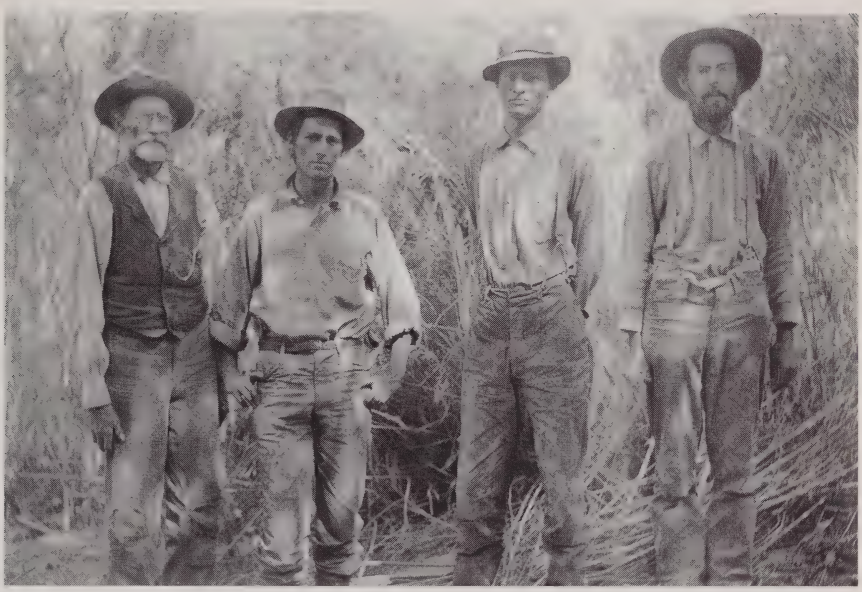

Fig. 3. Left to right: Frank Stephens, L. Hollister Jones, Joseph Dixon, and Joseph Grinnell along the Colorado River near Pilot Knob, California, 15 May 1910. Photograph taken by J. Grinnell at end of trip which started 15 February 1910. "The three months' field-work yielded 1,272 specimens of mammals, 1,374 birds, 443 reptiles and amphibians, 22 sets of birds' eggs and nests, a few fishes, and a collection of the more conspicuous plants" (Grinnell 1914:52). The collections and notes from this trip formed the basis for Grinnell's Ph.D. thesis (Stanford University), widely regarded as a classic in biogeography.

described fairly as anecdotal. Geographic ranges were known sketchily, if at all; taxa were described from scattered, poorly prepared specimens with woefully inadequate tag data; measurements were crude at best; and natural history information consisted typically of casual, fragmentary, and sometimes rather fanciful notes, all in keeping with the primitive conditions of the times. The Grinnell school was to change this situation abruptly with its invocation of dramatic new standards which removed natural history from its anecdotal setting. The quest for careful records and refined information was nowhere more succinctly described than in an unpublished MVZ document dated 2 July 1942, by Alden H. Miller (but based on previous versions by J. Grinnell), and entitled, "Suggestions as to collecting." This 10-page document, on paper of a size suitable for inclusion in the field notebook, was distributed to all MVZ field personnel. Although pertaining specifically to collecting, as its title indicates, the "Suggestions" document is replete with statements illustrating the kind of standards expected at the MVZ in general:

Page 1: "For each specimen always give altitude and county as well as *exact* [italics mine] place; for example: '3 mi. NE Lone Pine, 3700 ft., Inyo Co., Calif.' Note proper abbreviation for California [not 'Cal.', which could easily be confused with 'Col.' = Colorado]. Attend *minutely* [italics mine] to proper punctuation . . . Locality data to be given in notebook *precisely* [italics mine] as on specimen label."

Page 3: "In making out the skull tag, enter sex symbol, field number, and initials with Higgins eternal *ink* [italics theirs]. . . . In all cases write large and heavy so that the ink penetrates the fibers . . . Remember that fading of the number means the loss of a specimen."

Page 5: [When collecting] "save anything unrecognized, or *needed to back up notebook determination* [italics mine]."

Page 6: "NOTE TAKING In upper left-hand corner of *each and every* [italics mine] notebook page enter collector's name and year. . . . In catalogue enter for each specimen *all details* [italics mine] of data pertaining to take . . . enter sex, name of species, breeding data, measurements, weight, and, on occasion, color of iris and soft parts and deposition of fat [one needs only to examine specimens taken prior to recent decades in virtually *any* of the world's ornithological collections to appreciate the precocity of these standards. Furthermore, Foster and Cannell (1990) note the continued importance of upgraded data standards even in the modern era. Use a vernacular name of the species, if you are not *sure* [italics theirs] of the scientific name. Write *full* [italics theirs] notes, even at the risk of entering much information of apparently little value. *One cannot anticipate the needs of the future* [italics mine], when notes and collections are worked up . . ."

Page 8: "Ascertain present numbers and distribution of large mammals and birds as compared with former status. So far as possible get *definite* [italics mine] statements expressing ratio of abundance now, compared with a *definite* [italics mine] number of years back . . . Record *fully* [italics mine] all evidence as to human influence . . . " On the last page (10), just above his name, Miller wrote: "*Note* —Read above suggestions every few days, devoting half an hour or so to thoughtful consideration of the objects of our field work, which are: To ascertain everything possible in regard to natural history of the vertebrate life of the regions traversed, and to make careful record of the facts gathered in the form of specimens and notes, *to be preserved for all time* [italics mine]. All this is for the *information of others* [italics theirs]; strive to make your records in all respects clearly intelligible. Remember that the value of our manuscripts increases as the years go by and faunal changes take place. Some of our earlier note-

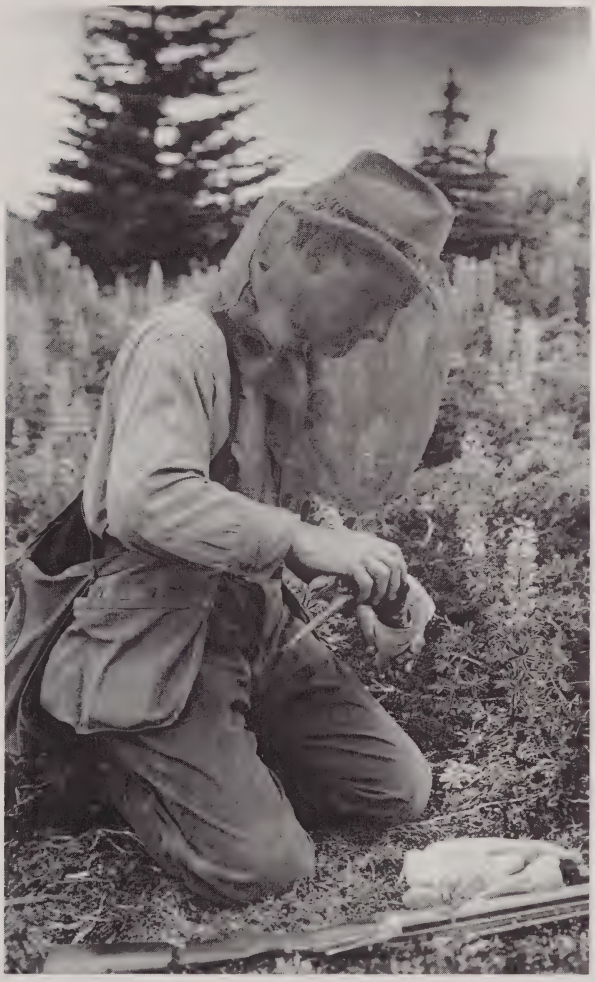

Fig. 4. Harry S. Swarth and mosquitos at timberline, Doch-da-on Creek, British Columbia, 23 July 1919. Swarth is placing a freshly-taken specimen into a paper cone to keep the plumage tidy. That day, Swarth catalogued 29 specimens, including 21 rosy finches (*Leucosticte*). The photographer, J. Dixon, prepared five Blue Grouse (*Dendragapus obscurus*). Swarth and Dixon had left camp at 6 A.M. for the long hike upslope. In his field notes for the day, Swarth described the view from the top of the mountain: "Looking up the Stikine River valley, as we could for a long distance on so clear a day . . . the change in topography eastward is very marked. The mountains from this point westward are rugged in the extreme, with towering rocky peaks and ridges, interspersed with glaciers of varying extent, and snow covered everywhere on the higher portions . . . The whole country is just a mass of mountains, jumbled together in a confused mass. There is no such regularity of construction as appears evident in the various mountain chains farther south but peaks rise beyond peaks, and ridges run in all directions."

books describe conditions now vanished in the localities they dealt with. Revised from previous editions prepared by J. Grinnell."

Herman (1986) has provided an exhaustive analysis of Grinnell's system of recording field notes, although he slights a major component of the system, that relating to specimen collecting (Johnson 1987).

The systematic organization of information according to species.—Modern natural history seeks to integrate within single species the often disparate facts of process-oriented fields such as development, physiology, and behavior. In its capacity for intelligible unification and integration of diverse information, natural history plays a unique role (Johnson 1985). Although many authors prior to Grinnell had published their anecdotal information in a species account format, none ascended to the level of detail or integration offered by Grinnell in all his major faunal works (Grinnell et al. 1918, Grinnell and Storer 1924, Grinnell et al. 1930, Grinnell and Miller 1944). In fact, one could argue that the single most important trend defining the beginning of scientific natural history was the emphasis on accumulating carefully documented data on a species-by-species basis as practiced by Grinnell and his immediate descendants.

I do not claim that at least some components of the Grinnellian tradition did not originate independently in other individuals at other institutions during the growth of vertebrate zoology in the first half of the twentieth century. Others before and during Grinnell's time studied and collected wild animals in the field and prepared journals. Nonetheless, Grinnell was the first to upgrade these practices to a *scientific* level where meticulous descriptions of habitat use, abundance, morphology, diet, and behavior were presented as integrated, species-specific life histories, where numerous specimens provided documentation across geography, and where complete accuracy was paramount at every step of the way. It was therefore Grinnell's elevation of anecdotal natural history to a dramatic new scientific plane through the general methodology discussed above that was the major ingredient of his enduring philosophy. Although the Grinnellian tradition began over three-quarters of a century ago with reference to taxonomic and faunal studies, the essence of its message still applies today to all aspects of modern field ornithology—carefully gathered detailed data, from birds living in their natural environments, are required to solve a multitude of continuing problems in systematics and ecology. Nothing less will suffice.

CONTRIBUTIONS OF RESEARCH AT MVZ TO THE GROWTH OF ORNITHOLOGY

Eakin (1956) describes Annie Alexander's remarkable foresight in planning the founding of the Museum of Vertebrate Zoology and in finding a suitable director. Miss Alexander wrote, "I should like to see a collection developed (especially of the California fauna) and would be glad to give what support I could if I could find the right man to take hold; someone interested not only in bringing a collection together *but with the larger object in view, namely gathering data that would have direct bearing upon important biological issues*" (italics mine). That Annie Alexander succeeded in finding the right man to build a collection cannot be in dispute. Here I will explore the degree to which ornithological research at the MVZ reached Miss Alexander's latter goal, the "larger object." In this exploration I have been cognizant of recent papers discussing the contributions of research on birds to progress in general biology (Mayr 1963, 1983, 1984; Konishi et al. 1989).

Since the first decade of the 20th century, research on birds at the MVZ has covered virtually every aspect of ornithology and has kept pace with the development of biology during this period of unparalleled growth. In this section I cite representative *examples* of studies that illustrate the breadth and depth of this research. For convenience, my comments are arranged under loosely defined subfields; other, perhaps more logical arrangements are possible. Furthermore, because this is a personal assessment, some subjectivity and bias have been unavoidable. Finally, my incomplete coverage will emphasize past rather than recent activity. I offer my condolences to those many former or present researchers at MVZ whose important papers I do not have space to mention.

Avifaunistics and biogeography.—Grinnell was one of western North America's most eminent faunists. His work and that of his associates during the early days of the MVZ focused on careful documentation and description of the ecological and geographic distribution of species of vertebrates, including birds, occurring in restricted regions, particularly of California (Grinnell 1914, Grinnell and Storer 1924, Grinnell et al. 1930). Alden Miller continued this tradition, eventually joining with Grinnell to produce (after Grinnell's death) the monumental, "Distribution of the Birds of California" (Grinnell and Miller 1944), with its meticulous scholarship and renowned habitat descriptions for each species covered. Miller's book on the vertebrates of Joshua Tree National Monument (Miller and Stebbins 1964) was his last major faunal work. These compilations all shared the same characteristics—reliable species accounts based on the firm founda-

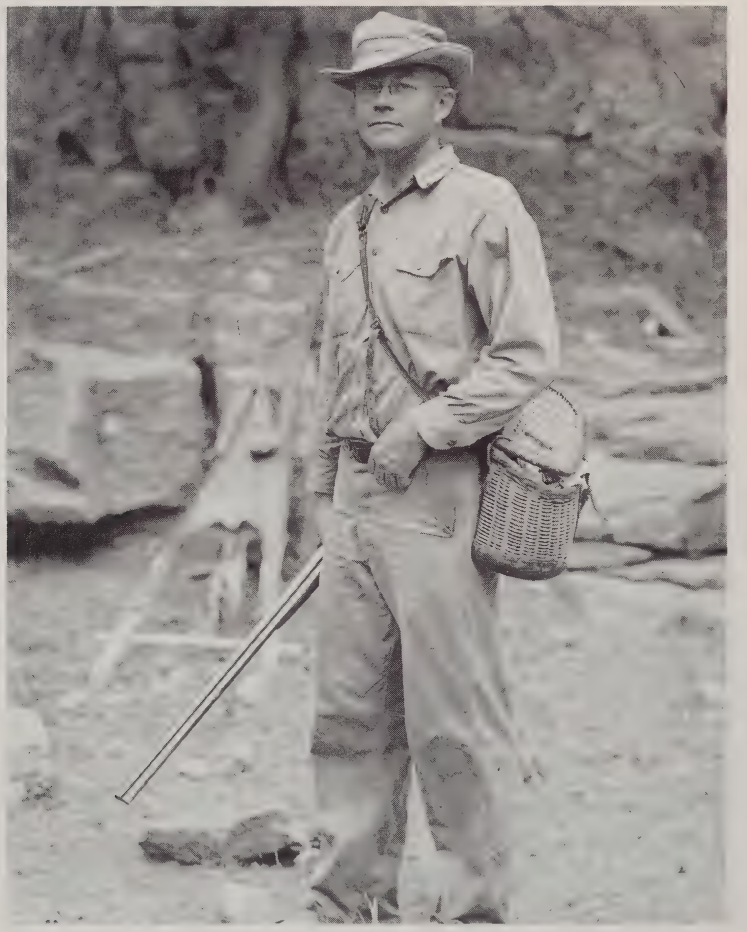

Fig. 5. Alden H. Miller near Gavilan River, Sierra Madre Occidental, Chihuahua, Mexico, September 1948. A vigorous field man, Miller would hike 5–10 miles per day in steep, rocky terrain, typically returning with at least one rarity among the series of expected species. His legendary skills at recognizing birds by voice led to many discoveries. Upon hearing a puzzling call or song while seated at the skinning table, Miller would lurch from the tent with his shotgun and usually return with a valuable specimen. Note the tennis shoes, worn on long day hikes and at night while hunting owls (in this instance, in rattlesnake country). The fishing creel, carried to protect bird specimens in paper cones, was common field gear for bird collectors. A wolf hide is drying on a wooden stretcher in the background. Leopold (1949) eloquently described the vanishing wilderness found by the field party from the MVZ during seven weeks of work in the region. Photograph taken by Robert McCabe.

Fig. 6. Ward C. Russell finishing a bird specimen inside the MVZ field tent, White Mountains, Inyo County, California, July 1954.

tion of detailed field notes on behavior and life history, collections of properly determined specimens, and analyses that described the relationships of the species assemblage to avifaunas of surrounding regions.

One contribution, however, Miller's (1951) analysis of the breeding avifauna of California, was qualitatively different. This treatment was the first to review the entire nesting avifauna of a large and diverse geographic region from the standpoint of several analytic systems (life zones, ecologic formations, and faunal groups). Miller's highly original method of categorizing and rating ecologic preferences of each species could only have been developed by someone intimately familiar with the habitat occurrence of California birds. Several major distributional generalizations were revealed, one of which is that except for predatory and scavenging species, birds in general are either very strict or moderately strict in their ecological occurrence. Surprisingly, this unique contribution to ecology and biogeography never had the impact it deserved. In fact, Mayr (1973:180) found Miller's monograph to be pedestrian and concluded: "As in much of the early ecological work [at MVZ], there was rarely a rising above the purely descriptive level." I strongly disagree.

Although avifaunal work has continued at the MVZ since the Grinnell-Miller era, most papers have taken a broader conceptual focus. For example, in a critique of Diamond's (1969) analysis of avifaunal data from the California Channel Islands, Lynch and Johnson (1974) alerted ecologists and biogeographers to the pitfalls inherent in deriving estimates of purportedly natural turnover on islands through simple comparisons of old and recent bird records, especially in regions disturbed through human agency. Because this paper originally had been rejected by *Evolution*, despite the fact that it refuted a major empirical support for the theory of island biogeography, Van Valen and Pitelka (1974) properly cited it as an example of intellectual censorship practiced by theoretical ecologists during that period. In another publication dealing with insular species numbers determined from years of specimen records, largely accumulated at the MVZ, Johnson (1975) offered hard data in support of the then-minority position that habitat diversity, rather than simple measures of area or distance to source avifaunas, was the principal dictate of bird species numbers on isolated mountaintops of the Great Basin. In another example which demonstrates the value of old avifaunal data, Johnson and Cicero (1985) compared reliable records obtained by the MVZ field parties one-half century earlier with modern data. They were able to document a surprising degree of temporal avifaunal change on San Benito Mountain, California, in which boreal species replaced those of warm and arid environments. Importantly, such claims are warranted only if *dependable* baseline information is available, thus reaffirming the need for the high standards embodied in the Grinnellian tradition.

In a study notable for its difficult logistics, thoroughness, and exotic setting (a transect from the coast to 4500 m elevation in the Peruvian Andes), Pearson and Ralph (1978) examined the ecological correlates of

Fig. 7. Sierra del Nido, Chihuahua, Mexico, June 1957. Notes on reverse side of photo: "Last day in camp. Taking a bath in what was our drinking water. Water hauled to this stock tank by a Mexican, for our use. Left to right: Alden Miller, Ward Russell, Vic Lewin, Starker Leopold, Pete Schramm, and Jim Anderson." Neither the name nor the gender of the photographer was recorded.

species richness and diversity of terrestrial vertebrates including birds. This report serves as another example of a field investigation in which basic faunistic and floristic data (tallies of correctly-identified species) for a set of localities were expanded to include censusing and quantification of ecological parameters in explaining regional variation in diversity and abundance.

Variation, systematics, speciation, and evolution.—Research on variation in birds and its application to problems of systematics and speciation

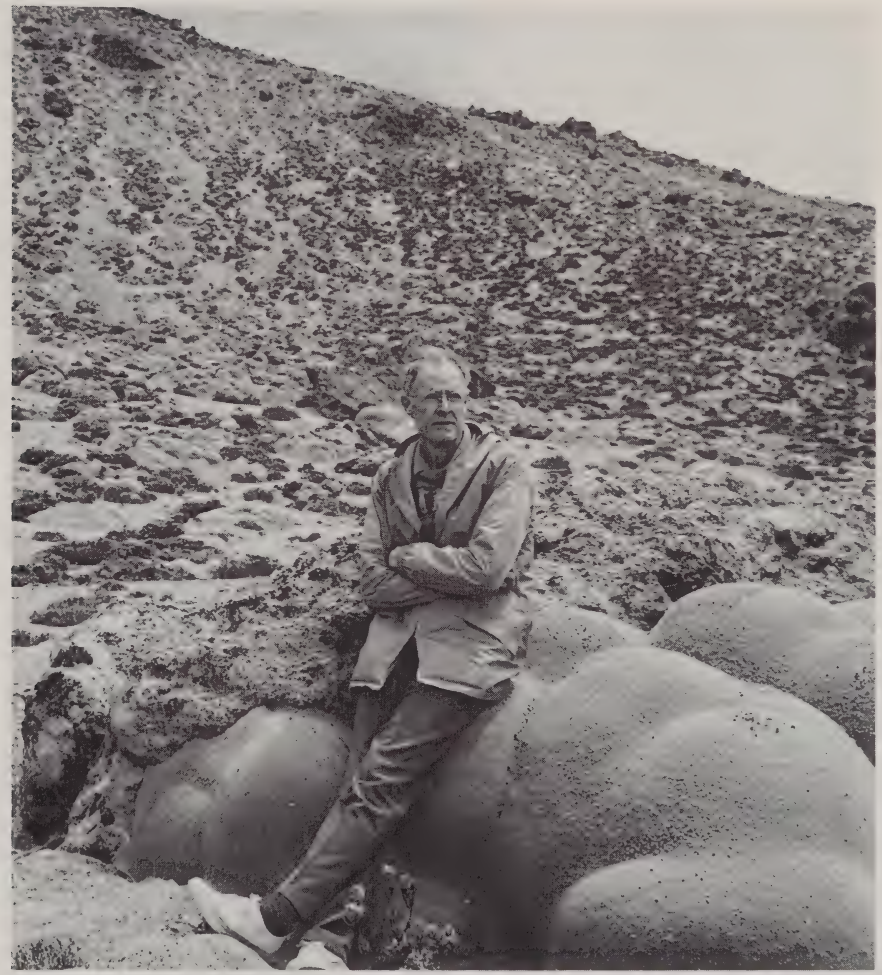

Fig. 8. O. P. Pearson at the Yareta study site (Pearson and Ralph 1978), 13 km NE Tarata, Dept. Tacna, Peru, 5 October 1971. According to Pearson (pers. comm., 13 April 1992): "This forlorn spot at 4500 m elevation near the continental divide in southern Peru was the highest camp in an Andean transect/census of birds, mammals, and reptiles. It was also the site of field observations on nesting hummingbirds, physiological studies of high-altitude lizards, and measurements of the glacial growth-rate of the green, coral-like heads of yareta (*Azorella compacta*) seen in the photo. Some of them may be more than 1000 years old. Temperatures fluctuated daily from –15 to +12 C . . . One bitter cold midnight a bus driver beat on our tent to waken us and borrow our car battery. His passengers had been pushing him for hours but couldn't quite get him over the last rise."

has been a central theme of research at the MVZ throughout its history. Grinnell and his associate Harry Swarth were intensely interested in variation in size and color of birds (Swarth 1920, Grinnell 1943). Grinnell was well ahead of his time in expressing an awareness of the three different dimensions involved in that variation—intrapopulational, interpopulational, and temporal. Both Grinnell and, later, Alden H. Miller, were pioneers in their treatment of the populational aspects of variation and in viewing subspecies as natural categories beyond mere static (typological) units.

A. H. Miller continued the kind of detailed systematic work instituted by his predecessors Grinnell and Swarth, but with several significant differences. For example, in his study of geographic variation in the American shrikes (*Lanius*), Miller (1931) incorporated the pathbreaking approach of segregating specimens into age classes for analysis. Moreover, he calculated statistics for the raw measurement data and was thus among the earliest of avian systematists to apply such a crucial refinement to the interpretation of variation. (To my knowledge, Linsdale [1928], also at the MVZ, was the first avian researcher to calculate statistics of dispersion [standard deviation and coefficient of variation] in his study of osteologic variability in the Fox Sparrow [*Passerella iliaca*]). But it was Miller's monograph (1941) on variation and hybridization in *Junco*, with its large, meticulously analyzed samples of specimens taken on their nesting grounds, that set new standards in avian systematics.

Although Miller himself would never complete another systematic analysis of such majestic proportions, his long series of students, and some of their academic offspring, carried the banner for the next four decades. Their publications on variation, hybridization, and speciation covered very diverse groups of birds: dowitchers (Pitelka 1950) and sandpipers (MacLean and Holmes 1971), sapsuckers (Howell 1952, Johnson and Zink 1983, Johnson and Johnson 1985), flycatchers (Johnson 1963, 1980), larks (Behle 1942 [research conducted under Grinnell]), jays (Pitelka 1951), Wrentits (*Chamaea fasciata*) (Bowers 1960), titmice (Dixon 1955), nuthatches (Norris 1958), wrens (Selander 1964), towhees (Sibley 1950, Davis 1951), sparrows (Marshall 1948a,b; Banks 1964; Baptista 1975; Wolf 1977; Zink 1986), and African finches (Smith 1990). Finally, Test's (1942) and Bower's (1956, 1959) papers on feather pigments and color determination and a series of papers on molt and pterylography (Pitelka 1945, Raitt 1961, Foster 1967a,b) were significant in the development of methodologies in avian systematics.

The modern era has seen the application of increasingly sophisticated research approaches. Studies now often incorporate multivariate treatment of several character suites (e.g., morphological, color, and vocal data [Johnson 1980, Groth 1993] as well as geographic appraisal of allozymic variability (Johnson and Zink 1983, Zink 1986, Johnson and Marten 1988,

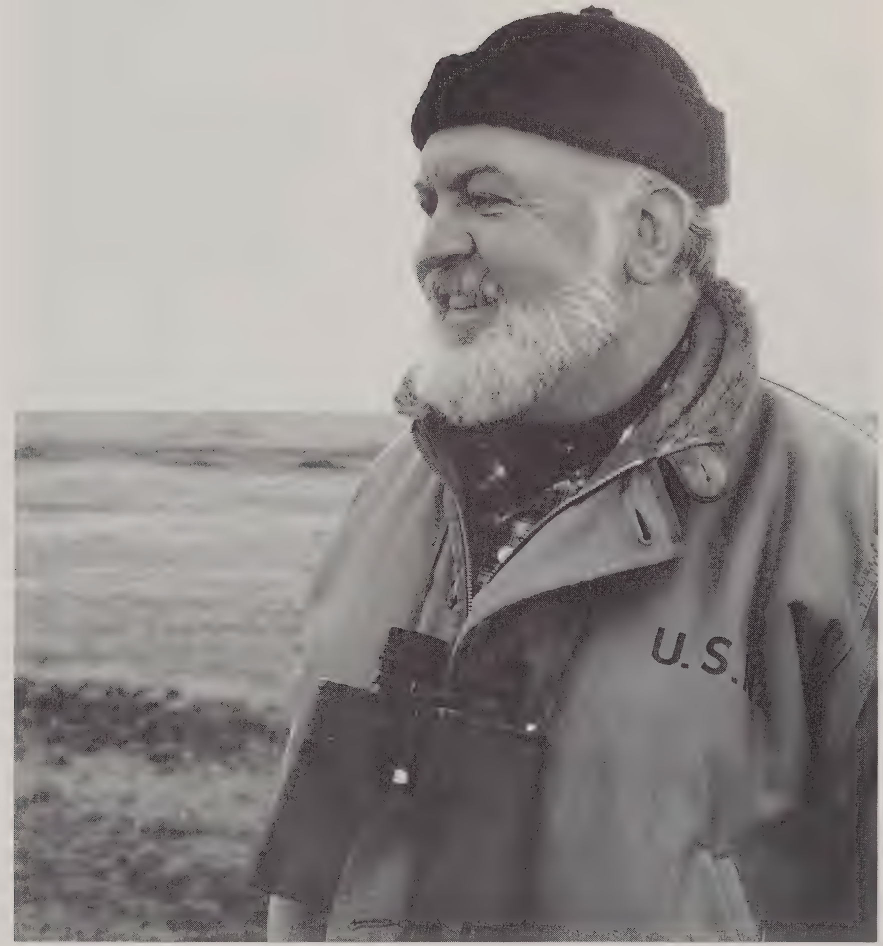

Fig. 9. Frank A. Pitelka in the field in the arctic. As Pitelka related (16 April 1992): "It is mid-June, near Barrow, Alaska, at 71 20' N. The tundra here is flat, wet, still easy to walk as the soil permafrost is still shallow. The temperature at 'night' (now full light) can fall below freezing any time during 'summer.' The sea ice still hugs the beaches; and over open leads (breaks in the ice), late straggling eiders are still flying east. The breeding season is now in full swing and longspurs, buntings, and shorebirds are in full song and much chatter. By comparison with lower latitudes, the summer's events are fast-paced, with unpredictable change and frequent surprises." A small portion of his three decades (1951–1980) of intensive summer field work on birds on the north slope of Alaska was summarized in Pitelka (1974). Photograph by Peter G. Connors, mid-June, 1975, near Barrow, Alaska.

1992) and base sequences of mitochondrial DNA (Johnson and Cicero 1991). The goal of recent work has been to document accurately the relationship of morphological, color, vocal, and genetic variation across geography in order to provide multidimensional estimates of population structure and differentiation. Collectively, the aformentioned investigations in avian systematics at the MVZ over the past half-century are among the most thorough ever conducted.

Other important research has concerned diverse kinds of evolutionary adaptation in woodpeckers (Burt 1930), geese (Miller 1937), thrashers (Engels 1940), tree-trunk foraging birds (Richardson 1942), Galapagos finches (Bowman 1961), and stifftailed diving ducks (Raikow 1970). Related studies of organismal form include Howard's (1929) osteologic

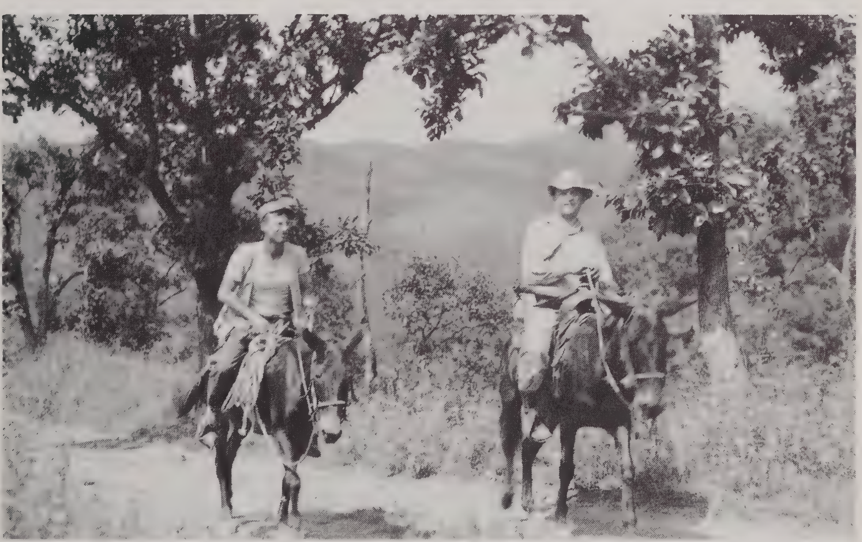

Fig. 10. Ward C. Russell (left) and Frank A. Pitelka on mules on trail above Santa Lucia, enroute to El Batel, 70 km NE Mazatlan, 5100 ft., Sinaloa, Mexico, 12 October 1946. The photographer, A. Starker Leopold, occupied a third mule. Four additional pack mules carried supplies. Their quest: the magnificent Dickey Jay (*Cyanocorax dickeyi*). One leg of the return trip involved a harrowing nighttime descent from the mountains atop a logging truck. In Russell's words (MVZ field notes, 21 October 1946): "At 8:15 P.M. we piled our equipment on top of a load of lumber and headed for Mazatlan. This was the hardest ride I have ever experienced. The road was rough, steep and our high position on top of the load exposed us to constant thrashing from overhanging brush & limbs most of which had thorns. Sleep was out of the question as one had to hang on to hand lines we had strung up in order to stay on the load. Arrived in Villa Union on the Rio Persidio at 8 A.M. where fortunately we caught a stage. Arrived in Mazatlan at 9 A.M. Oct. 23."

compendium and Fisher's (1946) treatment of the locomotory apparatus of New World vultures. Research on organismal function in birds has not been prominent at the MVZ over the years, but pioneering work on the incubation patch (Bailey 1952), early studies of hummingbird metabolism and a review of avian torpidity (Pearson 1950, 1953, 1954, 1960), and experimental investigations of orientation in waterfowl (Hamilton 1962a,b; Hamilton and Hammond 1960) are exceptions.

Fig. 11. Ned K. Johnson and daughter, Amy, wilted after a morning's search for Euler's Flycatcher (*Empidonax euleri*), at 13.3 km. by road north of Curuguaty, 950 ft., Dpto. Canendiyu, Paraguay, 26 September 1979. Our visit coincided with a severe heat wave marked by insignificant bird activity at dawn and dozens of gleaming butterflies attracted to sweaty washcloths hanging from the tent ropes. Photograph by Carla Johnson.

Monographic studies of single species.—Many of the aforementioned papers, although focused on systematics, variation, and distribution, also offered supplementary data on nesting behavior, habitat selection, diet, and other features of the general natural history of particular species. Other intensive treatments of single species dealt entirely with ecological and/or behavioral issues: Gullion (1952, 1953) on coots, Koford (1953) on the California Condor (*Gymnogyps californicus*), Pearson and Pearson (1955) on tinamous, Pitelka (1959) on sandpipers, Brown (1964a) on jays, Root (1967) on gnatcatchers, Willis (1967) on antbirds, Bock (1970) on woodpeckers, Verbeek (1973) on magpies, Balgooyen (1976) on kestrels, Carpenter (1976) on Andean hummingbirds, Leopold (1977) on quail, and Smith (1987) on African finches.

Of this group of publications, Root's (1967) contribution deserves special mention because it was the first clear articulation of the guild con-

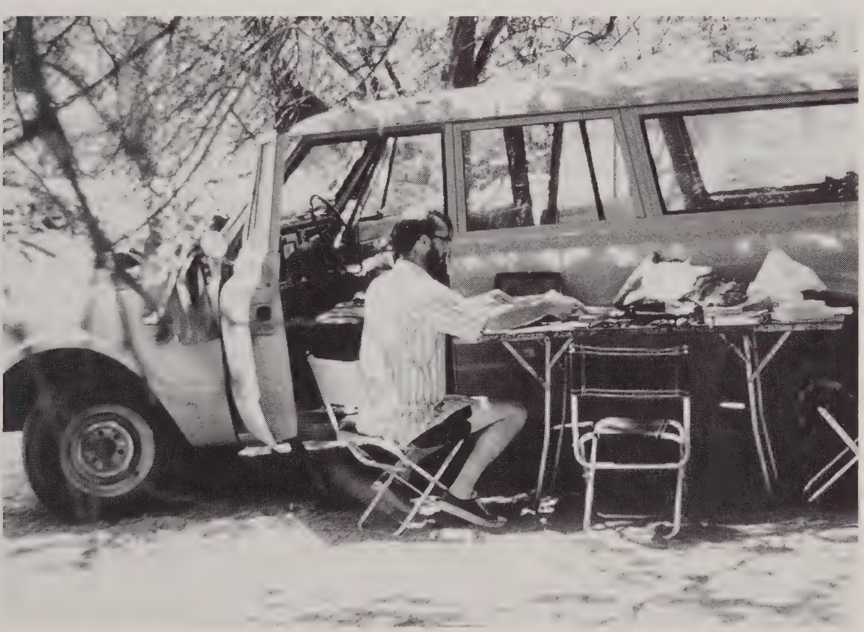

Fig. 12. Robert E. Jones preparing specimens in camp at Parinas, 100 ft., 7 km N & 15 km E Talara, Dpto. Piura, Peru; late October 1974. At this camp, in a mesquite woodland filled with birds, we awoke to a splendid dawn chorus. Other memories—loose herds of goats annihilating the understory vegetation and small wasps, attracted to bird carcasses on our skinning table, that stung our hands as we worked during the warm afternoons. Late one night we were startled by two drunken men on horseback who rode into the fading light of our campfire and demanded whiskey. Photograph by Ned K. Johnson.

cept in ecology (Simberloff and Dayan 1991). Moreover, it is timely to remember that Joseph Grinnell (1904, 1917) first proposed the concepts of competitive exclusion and the niche, concepts emanating directly from his preoccupation with detailed study of single species of birds.

Comparative studies of closely-related species.—Birds have provided biology with some of the best data in support of the often-unappreciated truth that pronounced differences in behavior and ecology can evolve even among very closely-related species. Documentation for this conclusion is offered by information from shrikes (Miller 1931), juncos (Miller 1941), dowitchers (Pitelka 1950), jays (Pitelka 1951), finches (Salt 1952), murres and guillemots (Storer 1952), nuthatches (Norris 1958), blackbirds (Orians 1961, Orians and Christman 1968), flycatchers (Johnson 1963, 1980), wrens (Selander 1964), jaegers (Maher 1974), sparrows (Wolf 1977), quail (Gutierrez 1980), warblers (Greenberg 1984), and kingfishers (Remsen 1990). Although not "closely-related," avocets and stilts are probably closest-living relatives and show an interesting combination of similarities and differences in ecology and behavior as documented in a monographic study by Hamilton (1975).

Annual cycles and their components.—A series of data-rich papers on annual cycles of birds, many of monographic proportions, have appeared in the MVZ publication record. Some studies have concentrated on breeding physiology, others stressed behavioral correlates, and a significant number have dealt with demographic features of populations in relation to environmental variables such as temperature and food. All are focused on single species, the only logical level at which to study adaptive evolution in coordinated parameters that change seasonally. Examples include studies of the Wrentit by Erickson (1938), sparrows (Blanchard 1941, Blanchard and Erickson 1949, R. F. Johnston 1956a,b), Hawaiian honeycreepers (Baldwin 1953), quail (Genelly 1955, Raitt 1960, Lewin 1963, Raitt and Genelly 1964), gulls (D. W. Johnston 1956a,b; Winkler 1985), finches (Thompson 1960a,b), blackbirds (Orians 1960, Payne 1969), sandpipers (Holmes 1966a,b; Myers et al. 1981), warblers (McDiarmid 1969), longspurs (Custer and Pitelka 1977), birds in general (Davis and Baldridge 1980), and fulmars (Hatch 1987a,b).

Albert Wolfson, A. H. Miller's graduate student, was the first researcher at the MVZ to investigate experimentally the regulation of reproductive and migratory cycles in birds (Wolfson 1941, 1942, 1945). In 1945, A. H. Miller began his own research on breeding cycles, especially in species of *Zonotrichia,* work which continued for two decades until his death in 1965. He was especially interested in the refractory period immediately following breeding, that time when photostimulation fails to elicit a gonadal response, and in the controls of breeding cycles near the equator where photoperiods are essentially constant. Mayr (1973) discusses at length Miller's fundamental research in this area.

Behavioral ecology.—Long before behavioral ecology was acknowledged as a distinctive subfield, a series of researchers at the MVZ, led by Frank A. Pitelka, recognized the relationship between the dispersion and availability of resources and the spacing patterns and social systems of birds exploiting particular kinds of environments. Orians' (1961) paper serves as a prime example. Other studies, for example Brown's (1964b) pathbreaking paper on the evolution of territorial systems in relation to competition and economic defendability, were equally influential. Although he completed this paper after leaving the MVZ, Brown acknowledges his debt to "Drs. W. J. Hamilton III, G. H. Orians, and F. A. Pitelka for arousing and sustaining my interest in territoriality by their ever-stimulating and illuminating discussions of the subject during the period of our common residency at the Museum of Vertebrate Zoology, University of California, Berkeley (1956-60)" (Brown 1964b:168). After the intellectually-intoxicating days of Orians, Brown, and Hamilton (which I most fortunately shared), research in behavioral ecology at MVZ ballooned to include shorebirds (Pitelka et al. 1974, Myers et al. 1981) with their diverse social systems. The heyday was reached in the early-1970s, with the onset of intensive research by MacRoberts and MacRoberts (1976) on the cooperatively breeding Acorn Woodpecker (*Melanerpes formicivorus*) at the Hastings Natural History Reservation, MVZ. Continuation and expansion of this work by teams of researchers watching hundreds of marked individuals of known genealogy has led to exceptionally detailed and insightful publications (Koenig and Mumme 1987 and references therein). During this same period, a careful field study of spacing patterns, bower distribution, and food caching in Macgregor's bowerbird (*Amblyornis macgregoriae*) illuminated the ecologic circumstances attending the evolution of social organization in birds (Pruett-Jones and Pruett-Jones 1982, 1985).

The work continues.

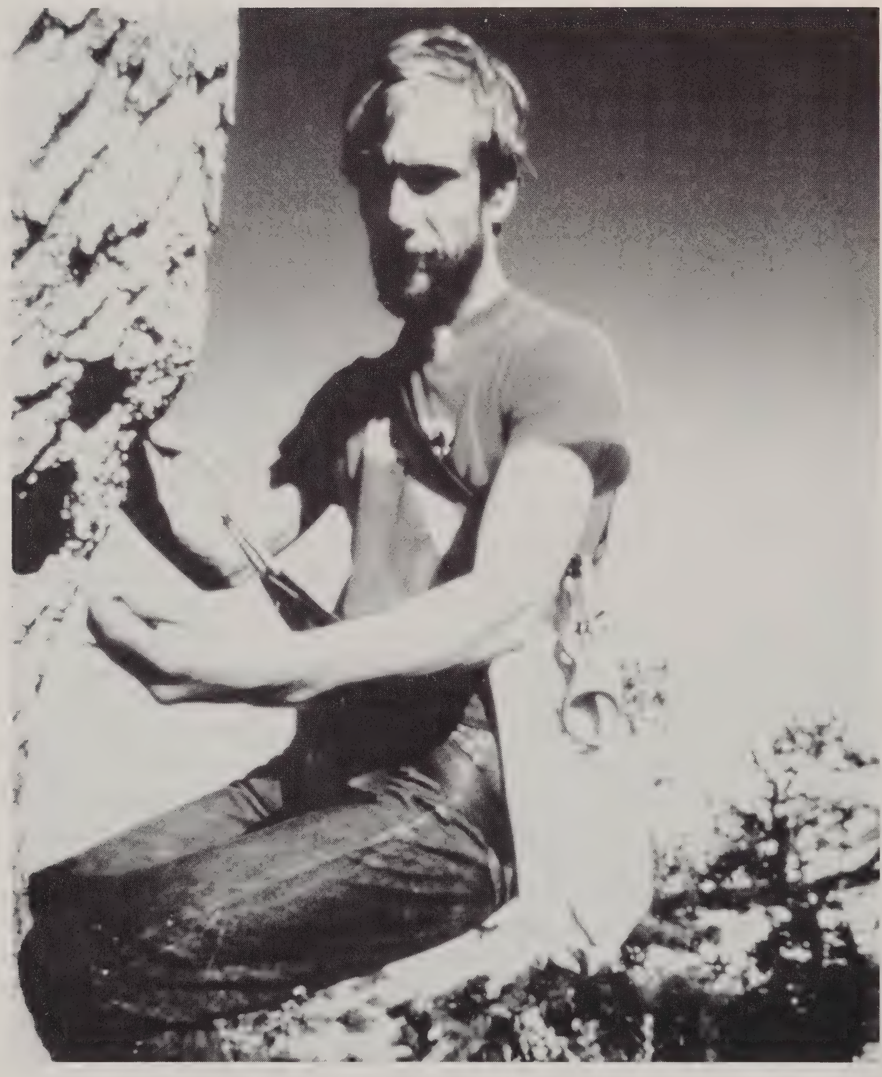

Fig. 13. Walter D. Koenig using climbing gear to examine an Acorn Woodpecker nest 30 ft above the ground at Hastings Natural History Reservation in early September, 1984, an unusually late nesting date for the species. Photograph courtesy of Galen Rowell/Mountain Light.

Fig. 14. Carla Cicero recording songs of the Plain Titmouse (*Parus inornatus*), in oak woodland near Moraga in the Berkeley Hills, Contra Costa County, California, on April 10, 1994.

ACKNOWLEDGMENTS

I am indebted to Seth B. Benson, Anne M. Caulfield, Carla Cicero, Betty Holland, Robert E. Jones, Karen A. Klitz, Walter D. Koenig, Dale McCullough, O. P. Pearson, Frank A. Pitelka, and Ward C. Russell for photographs, advice, and assistance.

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APPENDIX I

Brief Biographies of MVZ Ornithologists

Here I introduce the principal figures active in ornithology at the MVZ since its founding in 1908. The careers of at least seven deceased persons have been described in published obituaries; the reader is referred to these for details. Citations of publications provide representative examples of the person's research but in no instance convey more than a hint of the accomplishment of any individual. Names are listed in order of birthdate, when known; otherwise I insert them in their appropriate time period.

Annie M. Alexander (1867–1950).—Founder of MVZ in 1908, and generous benefactress thereafter. She and her lifetime companion, Louise Kellogg, personally obtained thousands of specimens on field expeditions for the Museum. H. W. Grinnell (1952, 1958) described her remarkable life and accomplishments. See Fig. 2.

Louise Kellogg (?–?).—Field Collector, irregularly from 1908 until 1941, obtaining vertebrates (mostly mammals), plants, and fossils from Alaska to the tip of Baja California (Kellogg 1916). I am unaware of a published biography. The only other record in MVZ archives of her life is an undated obituary from a Bay Area newspaper stating that she graduated from the University of California in 1901 and died at the age of 88.

Joseph Grinnell (1877–1939).—Naturalist, systematist, ecologist, and biogeographer who served as the first Director of the Museum, from 1908–1939, and was the dominant ornithologist at MVZ for the first three decades after its establishment. Grinnell's life has been treated by numerous biographers: (H. W. Grinnell 1940 [includes complete bibliography]; Fisher 1940; Linsdale 1942; Miller 1943, 1964; Herman 1986; Jones 1991). See Fig. 3.

Harry S. Swarth (1878–1935).—Systematist (Swarth 1920) and avifaunist (Swarth 1922), specializing on the birds of western North America. Assistant Curator (1908–1910) and Curator of Birds (1910–1927) at MVZ, except for 1913–1916, when he held a position as Assistant Director, Museum of History, Science and Art, Los Angeles (now called the Los Angeles County Museum of Natural History). Linsdale (1936a) published a biography of his life. See Fig. 4.

Margaret W. Wythe (1880–?).—Museum Assistant (1913–1925) and Assistant Curator of Birds (1925–1945). Expert in curatorial procedures (Wythe 1929, 1938) and compiler of distributional records (Grinnell and Wythe 1927). Retired in 1945.

Joseph S. Dixon (1884–1952).—Naturalist (Grinnell et al. 1930, Sumner and Dixon 1953); Field Collector, 1908 and 1910; Assistant Curator of Mammals (1915–1920); and Economic Mammalogist (1920–1931), MVZ.

Harold C. Bryant (1886–?).—Field Assistant, summer 1910, and Assistant Curator of Birds (1913–1914), MVZ. Collaborator from 1913–1914 in writing "The Game Birds of California" (Grinnell et al. 1918). In the summer of 1914, Bryant resigned to conduct educational work for the California Fish and Game Commission (where he started the publication, *California Fish and Game*).

Walter P. Taylor (1888–?).—Field naturalist and zoologist. Received Ph.D. in 1914 at University of California (presumably, Berkeley). Field Assistant (1908), Assistant Curator of Mammals (1909–1911), and Curator of Mammals (1911–1916), MVZ. In 1916 he left MVZ to become Assistant Biologist and, later (1924), Biologist, Bureau of Biological Survey, U.S. Department of Agriculture. Taylor worked extensively on mammals but published at least one major paper on birds (Taylor 1912).

Tracy I. Storer (1889–1973).—Assistant Curator of Birds, MVZ from 1914–1917, when he collaborated in writing "The Game Birds of California" (Grinnell et al. 1918) and "Animal Life in the Yosemite" (Grinnell and Storer 1924). Storer later became a prominent zoologist at the University of California, Davis.

Chester C. Lamb (?–?).—From 1925 to 1932, collector and preparator at MVZ, with extensive field experience in Lower California and the western United States. Field Catalog numbers in notes filed at MVZ range from 3955 (Lower California) to 16776 (California). No personal biographical data exist in MVZ archives. Sometime after 1932, Lamb collected extensively in Mexico for the Moore Laboratory of Zoology, Occidental College, Los Angeles.

Jean M. Linsdale (1902–1969).—Naturalist (Linsdale 1936c, 1957), compiler of distributional records (Linsdale 1936b), and birdbander. Research Associate at MVZ (1928–1937) and Resident Director (1938–1960), Hastings Natural History Reservation, MVZ. Behle (1971) wrote a detailed account of Linsdale's career.

Alden H. Miller (1906–1965).—Avian systematist (Miller 1931, 1941), ecologist-biogeographer (Grinnell and Miller 1944, Miller 1951), paleontologist (Miller 1944, 1963) and physiologist (Miller 1948, 1959). Director and leading ornithologist at MVZ from the end of the Grinnell era in 1939–1940 until 1965. Eakin et al. (1967), Davis (1967), and Mayr (1973) prepared memoirs of Miller's life. Mayr's account contains a complete bibliography. See Figs. 5 and 7.

Ward C. Russell (1907–).—Skilled and veteran collector, preparator, and field naturalist who concentrated on birds and mammals in the western United States and Mexico. Museum Zoologist (1929–1969), MVZ. See Figs. 6, 7, and 10.

A. Starker Leopold (1913–1983).—Conservationist and wildlife ecologist, emphasizing game birds and mammals (Leopold 1944, 1959, 1977), especially those of Mexico. Conservationist (1946–1967) and Acting Director (1965–1967), MVZ. See Raitt (1984) for an obituary and selected bibliography. See Fig. 7.

Carl B. Koford (1915–1979).—Naturalist, rugged outdoorsman, conservationist, and explorer. Authority on the California Condor (*Gymnogyps californianus*) (Koford 1953) and on the biota of South America. Research Associate and Associate Research Ecologist, MVZ.

Oliver P. Pearson (1915–).—Ecologist (vertebrates of South America [Pearson and Pearson 1955, Pearson and Ralph 1978]) and physiologist (torpidity in birds [Pearson 1960] and metabolism and energetics of hummingbirds [Pearson 1950, 1953, 1954]). Associate Curator (1955–1957) and Director (1966–1971), MVZ. Although primarily a mammalogist, Pearson guided the doctoral research of four ornithology students (Robert E. Bailey [Bailey 1952], F. Lynn Carpenter [Carpenter 1976], Rey C. Stendell, and Jennifer M. White). See Fig. 8.

John Davis (1916–1986).—Avian ecologist, with strong interests in annual cycles (Davis and Baldridge 1980), and systematist, emphasizing species of the American Southwest and Latin America (Davis 1951, 1965). Research Zoologist (1953–1982) and, from 1960–1982, Reserve Manager, Hastings Natural History Reservation, MVZ. Sibley and Pitelka (1988) prepared his obituary.

Frank A. Pitelka (1916–).—Systematist (Pitelka 1950, 1951), community ecologist (Pitelka 1955), and behavioral ecologist (Pitelka et al. 1974), with special interest in social systems (Pitelka 1979). Curator of Birds (1946–1963) and Associate Director (1982–present), MVZ. See Figs. 9 and 10.

Gene M. Christman (1926–).—Senior Scientific Illustrator (1956–1986), MVZ (Miller and Stebbins 1964, Orians and Christman 1968). Now retired. Participated in MVZ field trips in the western United States and Mexico.

Peter L. Ames (1931–).—Assistant Curator of Birds, MVZ (1965–1968).

Ned K. Johnson (1932–).—Systematist (Johnson 1963, 1980), avian biogeographer (Johnson 1975), and population geneticist (Johnson and Marten 1988, 1992), with emphasis on small land birds of western North America. Curator of Birds (1963– present), MVZ. See Fig. 11.

Robert E. Jones (1939–).—Skilled collector and preparator of vertebrates, with extensive field experience in South America (Johnson and Jones 1990). Museum Scientist (1969–present), MVZ. See Fig. 12.

Karen A. Klitz (1945–).—Principal Illustrator, MVZ (1987–present).

Victoria Dziadosz (1948–).—Assistant Specialist, MVZ (1977–1980).

Walter D. Koenig (1950–).—Behavioral ecologist (Koenig and Mumme 1987, Stacey and Koenig 1990) specializing on long-term study of cooperatively-breeding species. Assistant to Associate Research Zoologist (1982–present), Hastings Natural History Reservation, MVZ. See Fig. 13.

Janis L. Dickinson (1955–).—Research Associate, Hastings Natural History Reservation, MVZ. Behavioral ecologist, investigating bluebirds and insects.

Barbara R. Stein (1955–).—Curatorial Associate and Researcher (1985–present), MVZ, emphasizing mammals.

Carla Cicero (1959–).—Curatorial Associate and Researcher (1993–present), MVZ, concentrating on birds and frozen tissues of all vertebrates. See Fig. 14.

9

History of Ornithology at Cornell University

Gregory S. Butcher[1,3]
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ABSTRACT.—Cornell University has served as a world center of ornithological activities since the appointment in 1915 of Arthur A. Allen as one of the first Professors of Ornithology. More than 300 graduate degrees in ornithology have been awarded since Allen received his Ph.D. at Cornell in 1911; more than 100 of those students were Allen's. Graduate education in ornithology continues today at Cornell in a number of academic departments. Cornell University has also attracted an unusual number of artist/biologists, building upon the tradition of Louis Agassiz Fuertes, the son of a Cornell professor and perhaps the greatest bird illustrator. Cornell University ornithologists pioneered the recording of wild bird songs and remain leaders in this field today. Allen and Fuertes both were important figures in American popular culture and did much to promote birds and birdwatching to the American public. Allen's enduring legacy is the Laboratory of Ornithology, an independent, nonacademic branch of Cornell University, located at Sapsucker Woods, three miles from campus. The Laboratory houses a major Fuertes art collection, the Library of Natural Sounds, the Bioacoustics Research Program, Bird Population Studies, and an active education and publications program. Two newly endowed positions at the Laboratory augur well for the future of the Laboratory and its relationships with Cornell University.

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Cornell University was founded in 1865 as a university "where any person can find instruction in any subject." Given that sentiment, perhaps it should be surprising that Arthur A. Allen did not become Cornell's first Professor of Ornithology until 1915. However, either Allen or Thomas S. Roberts of the University of Minnesota was the first Professor of Ornithology in the world; most other universities were not willing to subdivide their disciplines so finely.

The history of ornithology at Cornell predates Allen's appointment. In 1870–71, Greene Smith of Geneva, New York, served as a nonresident lecturer in ornithology. He donated 362 mounted birds to the university, some collected on a Cornell expedition to Brazil in 1870. Arthur Allen reported that when he arrived at Cornell in 1904 as a freshman, ornithology was already being taught, but only as part of a course in systematic zoology and ecology that had been organized by two of Cornell's first biologists, David Starr Jordan and Burt Green Wilder, and first taught by Hugh D. Reed and T. L. Hankinson. Reed was an advisor for Allen's dissertation (1911, 1914). Another of Allen's advisors was herpetologist Albert Hazen Wright, who married Allen's sister, Anna.

Perhaps the most auspicious event to start Cornell University's long association with ornithology was the 1889 painting of a Passenger Pigeon (*Ectopistes migratorius*) (from a fresh specimen) by Louis Agassiz Fuertes, the fifteen-year-old son of a Cornell University professor of civil engineering. He was the shining light of Cornell ornithology from this first painting until his untimely death in 1927.

In reviewing the history of Cornell ornithology, we divide the subject into five areas: (1) research and teaching, (2) art, (3) bird sound recording, (4) popularization, and (5) activities of the Laboratory of Ornithology from the time it became an independent department of Cornell University in 1956.

RESEARCH AND TEACHING

Since 1925, at least one bird-oriented advanced degree has been completed at Cornell each year except for 1945. Through 1993, more than 300 bird-related advanced degrees had been awarded: two in the 1910s, 14 in the 1920s, 43 in the 1930s, 49 in the 1940s, 41 in the 1950s, 44 in the 1960s, 55 in the 1970s, and 47 in the 1980s (Appendix I). Many early graduate students were women. Most early students were Arthur Allen's, but in later years the following served as major professors: Peter Paul Kellogg, George Miksch Sutton, Charles G. Sibley, William Dilger, Donald Griffin, Ari VanTienhoven, William Wimsatt, Howard Evans, Oliver Hewitt, Gustav Swanson, Thomas J. Cade, and William Keeton. The Cornell ornithological tradition continues under current professors Stephen Emlen and Charles Walcott in the Section of Neurobiology and Behavior, Elizabeth Adkins-Regan and Timothy DeVoogd in the Department of Psychology, David Winkler and Richard Root in the Section of Ecology and Systematics, and Thomas Gavin and Richard Malecki in the Department of Natural Resources.

In addition to the more than 300 graduate students who received degrees at Cornell, a number of undergraduates received their first training in ornithology at Cornell, but completed graduate work elsewhere. Many of them contributed specimens to the Cornell collection: Walter Bock, Robert Dickerman, Robert Mengel, Eugene Morton, Bertram Murray Jr., James Rising, Harrison Tordoff, Glen Woolfenden, and others.

Allen's thesis (1911, 1914) was the first at Cornell devoted to birds. The next avian Ph.D. thesis was not completed until 1923. By 1933 fewer than 30 Ph.D.s had been awarded in ornithology in the United States and 16 were from Cornell (Allen 1933). Of the 39 U.S. graduate students in ornithology in 1933, 21 were at Cornell.

Allen served as major professor for more than 100 graduate students, including many who graduated with non-thesis master's degrees (Anon. 1962). Pettingill (1968, 1992) fondly recalls the active days of Allen's "Grad Lab" in the early 1930s. Many of the theses completed under Allen were life history studies of single species (including studies of plumages and molts). A number of faunal studies were of geographic areas, ranging from the Cornell campus (Knappen 1926) to Madagascar (Rand 1932). Other theses explored questions of systematics, ecology, behavior (especially, but not exclusively, vocal communication), and population biology.

Allen's major scientific research, after his thesis work, was on screech-owls (*Otus*) (Allen 1924) and Ruffed Grouse (*Bonasa umbellus*) (Allen 1934a). He was the first to raise Ruffed Grouse in captivity and to prove by studying individual frames of motion pictures William Brewster's assertion (Brewster 1874) that male Ruffed Grouse create their drumming sound when their wings beat forward through the air (Bent 1932). Although he produced many students who had successful academic careers, Allen published relatively few papers in scholarly journals in contrast to his prolific contributions to *Bird-Lore* and *National Geographic*.

Allen taught Introductory Ornithology, Advanced Ornithology, and Applied Ornithology (including the techniques of photography and sound recording) (Allen 1933). The latter course was eventually taken over by Peter Paul Kellogg and had the requirement that each student present a 15–minute radio program in Kellogg's "Know Your Birds" series. In addition, in 1917 he taught the first courses in North America on wildlife conservation and game management. For many years, Allen, assisted by his wife Elsa and Peter Paul Kellogg, taught a summer course in ornithology

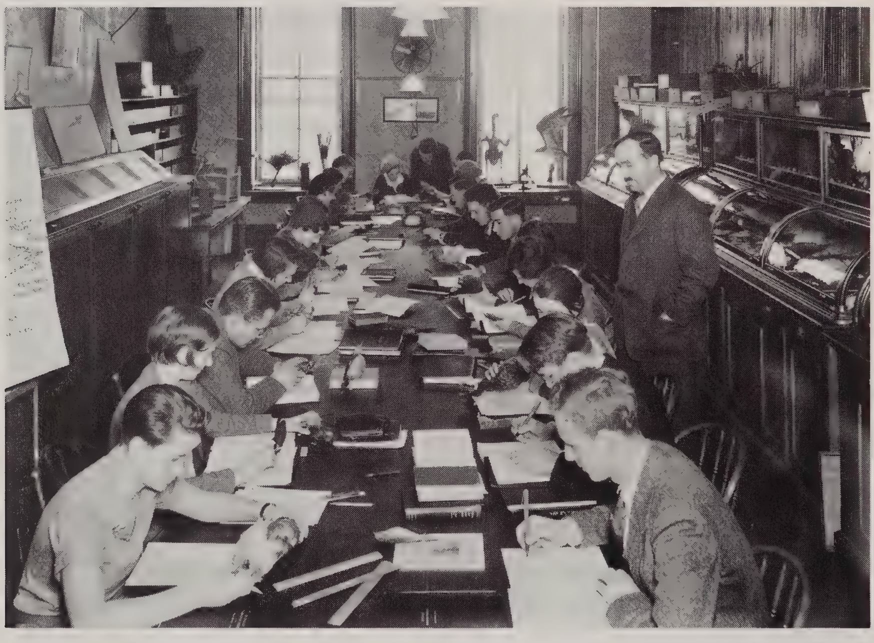

Fig. 1. Arthur Allen overseeing his Ornithology class at Cornell in about 1925.

attended principally by school teachers. To help his teaching, Allen published a laboratory notebook (Allen et al. 1927) and a textbook (Allen 1930), both of which went through several editions.

Allen helped to found the Eastern Bird Banding Association (EBBA) and the Northeastern Bird-Banding Association (now Association of Field Ornithologists) in 1922 and The Wildlife Society (TWS) in 1936. He served as the first president of EBBA and the second president of TWS.

George Miksch Sutton (1932) received his Ph.D. under Allen and stayed on to become Curator of Birds until 1943, when he left for the Army Air Corps. After the war, he went to the University of Michigan and then the University of Oklahoma. While at Cornell, Sutton traveled on collecting expeditions to Mexico, Oklahoma, New York, West Virginia, Mississippi, Louisiana, Texas, British Columbia, and Southampton Island, Hudson Bay.

From 1943 to 1953, the management of the ornithological collections was a paid graduate student position. The collections continued to grow under the auspices of students Dwain Warner and Kenneth Parkes. Student assistant curators after 1953 included William C. Dilger, David West, Neal Smith, Eric Johnson, John Weske, A. Richard Weisbrod, and Stanley

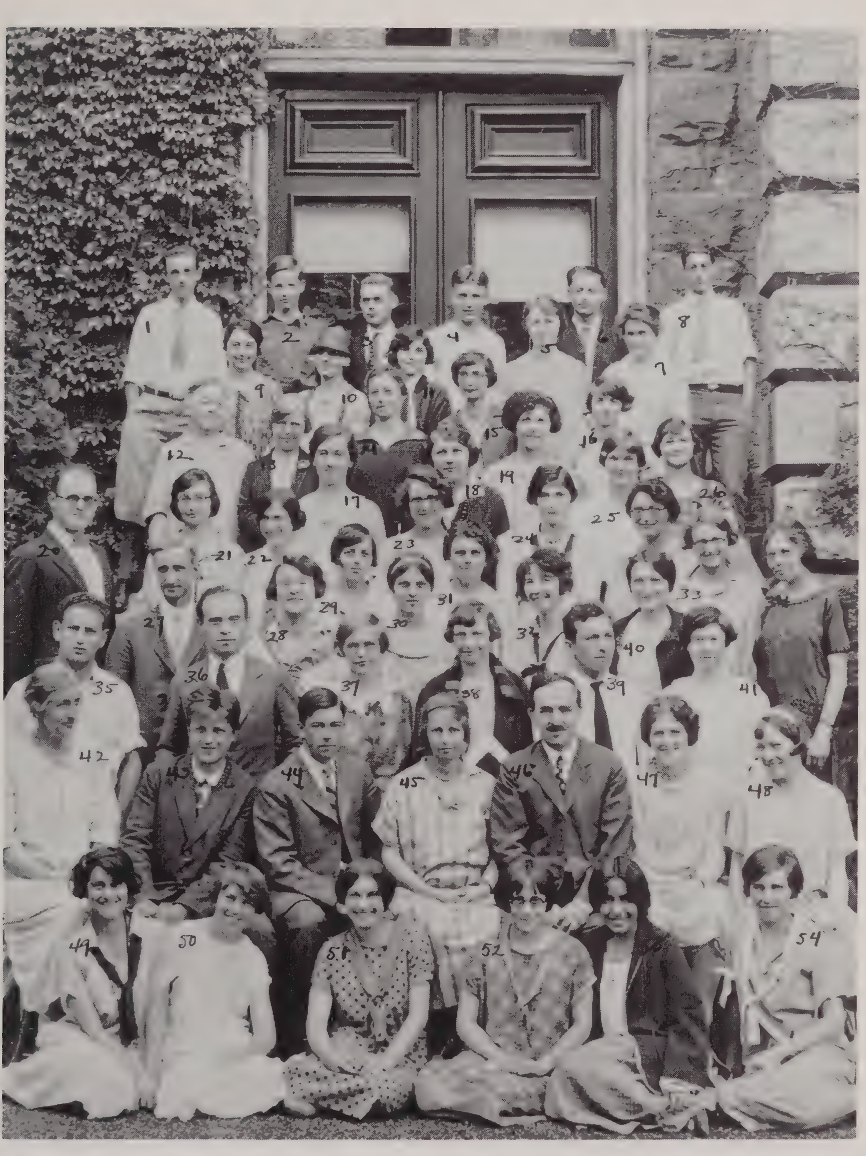

Fig. 2. The summer Ornithology and Advanced Ornithology classes in 1925. Elsa Guerdrum Allen (Arthur Allen's wife) is in the center of the second row from the bottom. Arthur Allen is on her left and Miles D. Pirnie (a teaching assistant) is on her right. Peter Paul Kellogg and John T. Emlen, Jr., are the two students in the upper left of the picture.

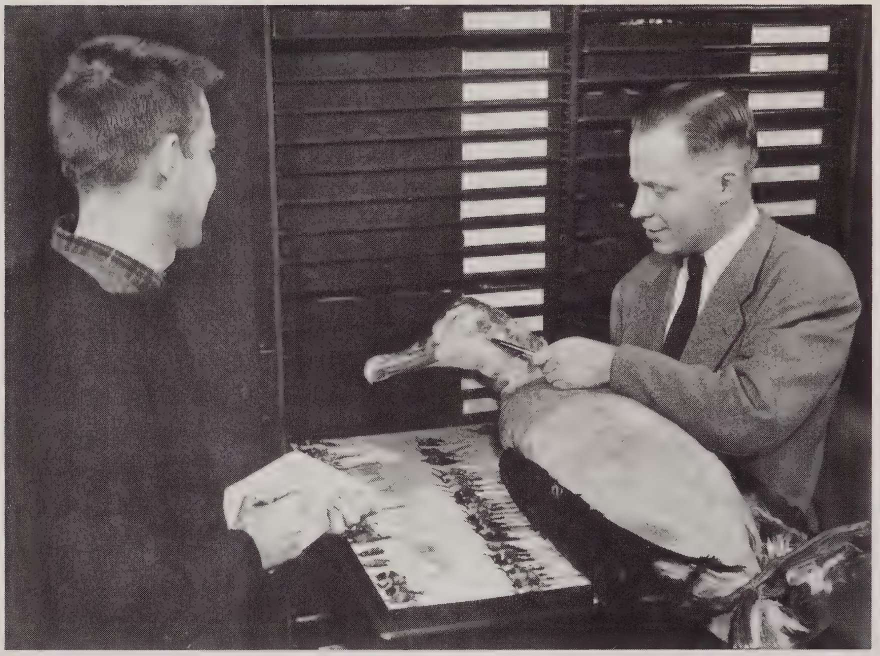

Fig. 3. Student Curator Kenneth C. Parkes showing off a one-hundred-year-old Wandering Albatross (*Diomedea exulans*), about 1950.

Temple. The assistant curatorship became a full-time, nonstudent position in 1970 with the hiring of Rollin Bauer. Kevin McGowan became the first Associate Curator with a Ph.D. degree in 1988.

When Allen retired from teaching in 1953, Charles Sibley took his position on the faculty. While at Cornell, Sibley sponsored a research program on avian hybrid zones in the Great Plains and Mexico that produced graduate theses and dissertations and specimens for the Cornell collection. Also at Cornell, Sibley undertook an analysis of the value to systematics of the egg white proteins of birds. Sibley was curator of the bird collection until he left for Yale University in 1965.

William C. Dilger received his Ph.D. at Cornell, studying behavior and systematics of thrushes (genera *Hylocichla* and *Catharus*; Dilger 1955). He stayed on as a researcher, financed at first by the R. T. French Company, and became a professor and Assistant Director for Research of the Laboratory of Ornithology. He did trend-setting work in ethology, principally using *Agapornis* lovebirds, and sponsored many graduate students.

William T. Keeton received his Ph.D. from Cornell in 1958 for work on millipede systematics and joined the entomology faculty that year

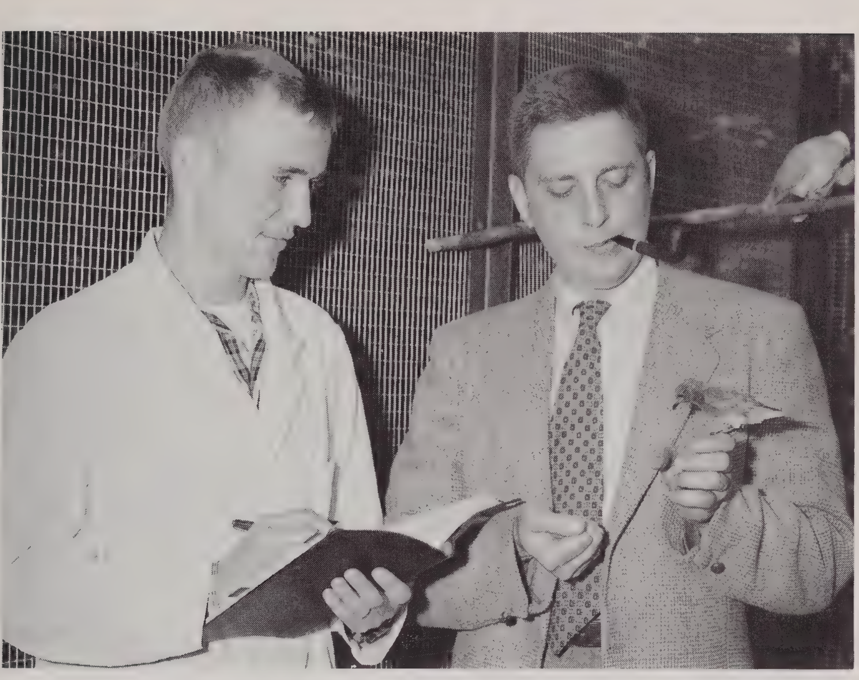

Fig. 4. Robert W. Ficken and William C. Dilger in the aviary at the Laboratory of Ornithology. Photograph by Richard B. Fischer, courtesy of the Cornell Laboratory of Ornithology.

(Emlen 1981). When the biological sciences were reorganized in 1965, he moved to the Section of Neurobiology and Behavior where he began work on the orientation and navigation of Rock Doves (*Columba livia*). The "Cornell Pigeon Project" produced numerous papers and graduate students over the next decade and a half. Keeton died in 1980, and the project was taken over the following year by Charles Walcott, who became Executive Director of the Laboratory of Ornithology at the same time.

John Emlen received a Ph.D. at Cornell (1934), became a Professor at the University of Wisconsin, and produced a lineage of ornithologists. This included sons John Merritt and Stephen, who became a Professor at Cornell in 1966. Stephen's early research was on nocturnal orientation in birds, but he later switched his emphasis to mating systems and social behavior.

After Charles Sibley left Cornell, his position on the faculty was taken by Tom Cade in 1967. Cade also became Research Director of the Laboratory of Ornithology and Curator of Birds. While at Cornell, Cade launched The Peregrine Fund and pioneered a number of techniques in

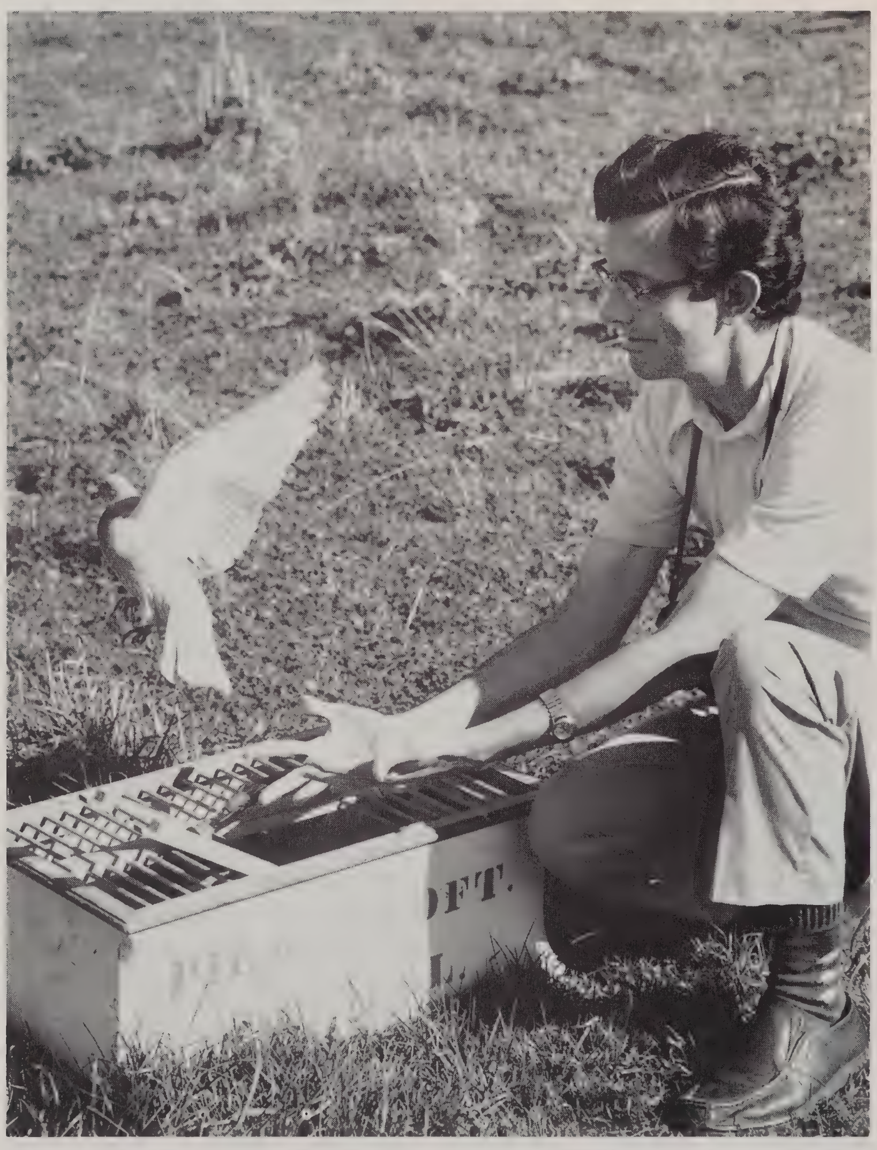

Fig. 5. William T. Keeton, working with pigeons ca. 1975.

captive breeding of raptors and their reintroduction into the wild. When Cade retired from Cornell in 1988, David Winkler took his positions as a faculty member in Ecology and Systematics and as Curator of Birds.

Fig. 6. Tom J. Cade with a Peregrine Falcon (*Falco peregrinus*).

ART

The story of bird art at Cornell is dominated by Louis Agassiz Fuertes (Boynton 1956, Marcham 1971, Sutton 1979, Peck 1982, Parkes 1992). He lived his entire life in Ithaca, although he was only on the staff at Cornell for the last three years of his life, as a Lecturer in Ornithology.

Many consider Fuertes to be the greatest bird illustrator. His most influential teachers were Abbott Thayer and Thayer's son Gerald (Boynton 1956, Marcham 1971, Peck 1982). Fuertes was excited about their theories of concealing coloration in birds (Thayer 1909). The Thayers, however, were disappointed that Fuertes chose to work as a bird illustrator, which necessitated drawing conspicuous birds, rather than as an artist, where he might be more free to draw birds that were concealed against their natural backgrounds.

Fuertes' career as an illustrator began dramatically at an early age when Elliott Coues noticed his talent and offered him work. The first book illustrated by Fuertes was published in 1896 (Merriam 1896); two were published posthumously (Fuertes and Osgood 1936, Oberholser 1974).

One of the keys to Fuertes' success as an illustrator of birds was his investment in fieldwork and biology. He collected a large number of birds (which are now in the Cornell University collection) and sketched and painted many birds with fresh specimen in hand.

Fuertes' biological talents were not limited to art (Chapman 1927). He was an accomplished musician and had a musician's ear for bird song. He published a series of six articles in *Bird-Lore* on the songs of neotropical birds (Fuertes 1913, 1914a–e). Fuertes was an accomplished writer, and his biographers provide examples of the beautifully expressive language of his letters. Cornell took advantage of Fuertes' gifts as a speaker and as a person by appointing him Lecturer in Ornithology in 1923 (Allen 1927).

George Miksch Sutton also combined talents in art and biology. Sutton was apprenticed to Fuertes for the summer of 1916, when Sutton was 18 and Fuertes was 42. The two maintained a long correspondence in which Fuertes constructively criticized Sutton's paintings (Sutton 1979). Unlike Fuertes, Sutton made his living as a biologist, working at the Carnegie Museum in Pittsburgh, as State Ornithologist in Pennsylvania, and then as a graduate student and Curator of Birds at Cornell. Later, he was Curator of Birds at the University of Michigan, and finally Curator of Birds and George Lynn Cross Research Professor at the University of Oklahoma. Sutton published a dozen books and about 250 professional papers, many of them illustrated by his artwork (Pettingill 1984). Ironically, Sutton came to Cornell to be Arthur Allen's graduate student only after the death of Fuertes.

Robert Mengel, a Cornell undergraduate before and after World War II, also combined art and biology. Like Sutton, Mengel made his living as a biologist, mostly at the University of Kansas as Curator of Birds and Professor of Systematics and Ecology (Tordoff 1991). Mengel studied informally with Sutton both at Cornell and at Michigan while he was a graduate student (Peck 1991). Mengel is best known for his book on the birds of Kentucky (1965). His drawings appear in the *Handbook of North American Birds* (Palmer 1962, 1976, 1988).

William Dilger, who received his Ph.D. at Cornell in 1955, was another in the line of artist/biologists at Cornell. Dilger's art appeared frequently in *The Living Bird*, from a color plate of *Agapornis* parrots (Dilger 1962) to a cover painting of a Wood Thrush (*Hylocichla mustelina*; Dilger 1977). Dilger drew almost all the line drawings for *The Living Bird* from 1962–69.

BIRD SOUND RECORDING

Since 1929, individuals at Cornell have been world leaders in the recording of bird sounds in nature (Gross 1933, Allen 1937, Kellogg 1962, Boswall and Couzens 1982, Harwood 1987). In 1929, the Fox-Case Movietone Corporation asked Arthur Allen for help in recording a singing wild bird. In Stewart Park in Ithaca, Arthur Allen and Peter Paul Kellogg helped the movie technicians record a Song Sparrow (*Melospiza melodia*), Rose-breasted Grosbeak (*Pheucticus ludovicianus*), and House Wren (*Troglodytes aedon*) on motion-picture sound film. These 1929 wild bird recordings were the first in the New World (Boswall and Couzens 1982).

Also in 1929, Albert R. Brand enrolled at Cornell University as a special student in ornithology and became interested in recording wild bird songs. He had given up his seat on the New York Stock Exchange in 1928, before the stock market crash, and had the financial means to invest in the expensive equipment required to record bird songs. By the end of 1931, Brand and M. Peter Keane, a Cornell undergraduate, had recorded 41 species of birds and had presented their recordings at a meeting of the American Ornithologists' Union. In early 1932, Brand and Keane published

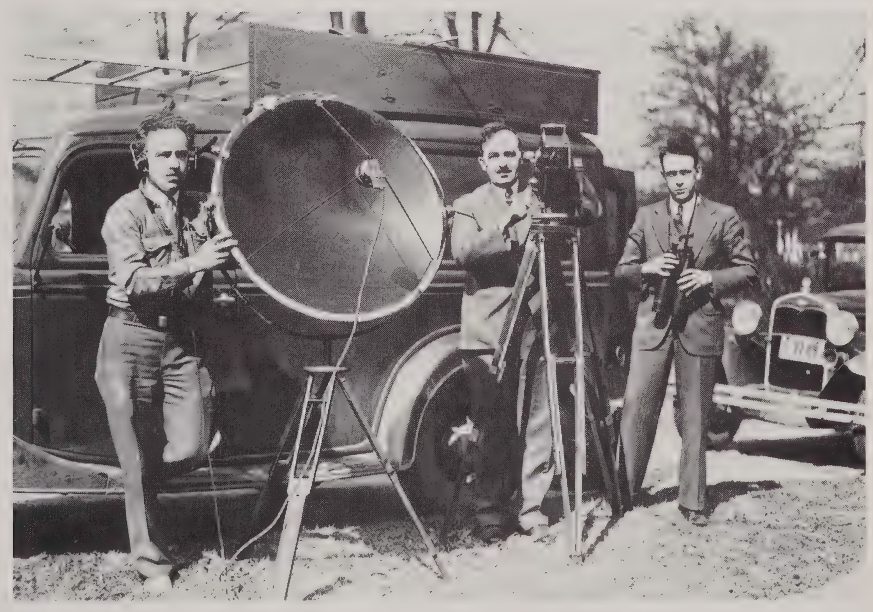

Fig. 7. Peter Paul Kellogg, Arthur A. Allen, and James T. Tanner outfitted for a 1935 expedition to photograph and record the sounds of vanishing species.

the first record of wild bird songs, *Bird Songs Recorded from Nature.* Also in 1932, Keane suggested use of a parabola to focus sound from the singing bird. In 1935 and 1939, Brand sponsored two North American expeditions to record bird songs (Allen 1937, 1944). Boswall and Couzens (1982) credit Brand with ten publications of wild bird songs, including one posthumous double record and two books accompanied by records (Brand 1934, 1936).

Allen and Kellogg published two bird song collections in the early 1940s on 78 rpm records before World War II caused a temporary halt in their activities. Included was the six record collection *American Bird Songs* (1942). Preparation of this set and much of the Cornell work on bird sounds since 1929 was assisted by professors in Cornell's engineering and physics departments.

In 1944–45, Allen and Kellogg worked on recording natural sounds in Panama at the behest of the U.S. military, using a direct-to-disk method. In 1949, direct-to-disk recording was replaced by the magnetic tape recorder. Tapes were reel-to-reel until the 1970s when cassette tapes became popular. Digital tape recorders are now available for field use.

Other major records produced by Allen and Kellogg include (with year of publication in parentheses): *American Bird Songs,* Volume II (1951), *Songbirds of America in Color, Sound, and Story* (1954), *An Evening in Sapsucker Woods* (1958), *A Field Guide to Bird Songs of Eastern and Central North America* (1959), *Dawn in a Duck Blind* (1960), *Bird Songs in Your Garden* (1961), *A Field Guide to Western Bird Songs* (1962), *Bird Songs of Garden, Woodland and Meadow* (1964), *Bird Sounds of Marsh, Upland and Shore* (1965), *Bird Songs in Literature* (1967, with Joseph Wood Krutch), and *Bird Songs of South Carolina* (1971). New recordings released from Cornell's Library of Natural Sounds in the 1980s and early 1990s include new versions of the two North American Peterson field guides (east and west) and a tape to accompany the North American field guide published by the National Geographic Society.

The recording of bird sounds and production of records and tapes for sale created a large body of recorded material that is useful for many purposes. To make this material easily accessible, Peter Paul Kellogg and his wife Byrl created the Library of Natural Sounds. The library now includes nearly 90,000 cuts representing almost 5,000 species of birds, the largest archive of natural sounds in the world. James Gulledge was hired in 1974 as Curator of the archive after the Kelloggs retired; upon his retirement in 1987, Greg Budney became Curator. The interaction of research in bioacoustics and the collection of natural sounds continues today through the Bioacoustics Research Program at the Laboratory of Ornithology under the direction of Christopher Clark.

POPULARIZATION OF ORNITHOLOGY

Arthur Allen has two major claims to fame: one as a great teacher, the other as a popularizer, who sparked the interest of the American public in birds and bird life (Fischer 1965).

It may seem strange that someone at a large research university like Cornell, with many graduate students, would spend so much energy in popularizing ornithology. However, in the context of the Cornell of Allen's time, it would be more surprising had Allen *not* been a popularizer. Cornell University was a leader in agricultural extension work and more specifically in outreach activities relating to nature study (Palmer 1944). Cornell's efforts were formalized under the name of the Cornell Nature Study Movement.

Today we make strong distinctions among pure research, applied research, training of researchers and college professors, training of public school teachers, public lectures and field trips, and the education of children. In Allen's day, all these activities fit naturally into a single career.

In 1888 Liberty Hyde Bailey joined the College of Agriculture at Cornell and in 1903 became Dean and published *The Nature-Study Idea* (1903). Bailey supported outreach work in nature study in a variety of ways. In 1893 Anna Botsford Comstock and James Rice carried out a prototype nature study with children in Westchester County, and in 1894 the New York state legislature appropriated money for extension activities including specific authorization for nature study in rural schools (Palmer 1944). Before the end of the century, 35,000 children had joined Junior Naturalist Clubs (the predecessors of 4-H Clubs), 25,000 teachers were receiving teachers' leaflets, and 2500 farm homes were enrolled in the Home Nature Study Course. The School of Education was opened in 1907, and a Department of Rural Education opened in 1918.

Although the Nature Study Movement was centered in the School of Education and in Cornell extension activities, the publications of the movement relied on professors like Arthur Allen in the Cornell academic departments. Louis Agassiz Fuertes also wrote (and illustrated) some of the early literature.

The National Association of Audubon Societies (later renamed National Audubon Society), under the leadership of William Dutcher, began children's educational programs at about the same time as the Cornell Nature Study Movement. Dutcher's first children's pamphlets on birds were issued in 1903; many of them were illustrated by Fuertes. In 1910, the first Junior Audubon Clubs were formed, and *Bird-Lore* began its "School Department." In 1919, Arthur Allen became editor of the School Department, a post he maintained until 1934, the year Frank Chapman retired as editor of *Bird-Lore* and the year Roger Tory Peterson took over staff responsibility for the Junior Audubon Clubs, including writing articles similar to Allen's in *Bird-Lore.*

Allen began his career as a popularizer by writing for *Bird-Lore* magazine at the urging of its editor, Frank Chapman (Allen 1912). Most of his articles in *Bird-Lore,* including many of the articles in the School Department, were on bird behavior. *Bird-Lore* began publishing Allen's photographs in 1914, many of which were notable for illustrating dynamic behaviors. On the pages of *Bird-Lore,* Allen began his series of bird biographies, which were later collated into two books (Allen 1934b, 1939). In book form, these biographies were accompanied with portraits by George Miksch Sutton. The articles were called "autobiographies" because Allen wrote the stories in the first person, from the bird's viewpoint.

When Allen concluded his editorship of the School Department at *Bird-Lore,* he published his first of 20 articles in *National Geographic*: "Blackbirds and Orioles" (1934c). His *National Geographic* articles included summaries of North American bird groups and reports on Allen's expeditions, mostly in North America. The *National Geographic* articles were reprinted in book form (Allen 1951, 1961, 1963).

Allen took many motion pictures of birds. He toured the country with the Audubon Screen Tours, especially after his retirement as a professor in 1953.

Allen was active in popularizing birds in his local area. He and Fuertes started the Cayuga Bird Club in 1913 (Fischer 1965). Although the club was dormant from the 1930s until 1973, it now has more than 180 members. Allen started a number of birding traditions in the Cayuga Lake basin, including a New Year's Day Count (split in 1963 to become three Christmas Bird Counts) and a May Big Day count. On New Year's Day, the Allens hosted a turkey dinner for all participants; on the May Big Day, the Allens provided a breakfast at their home and a picnic dinner at Montezuma National Wildlife Refuge.

Allen started an evening seminar series in the 1920s that continues today. At the seminars, Allen began the practice (which also continues today) of reading through the checklist to determine what birds had been seen in the Cayuga Lake basin during the previous week. The results through 1972 are incorporated in a scientific paper on population trends of birds in the Cayuga Lake basin (Temple and Temple 1976).

Arthur Allen's work in popularizing ornithology continued at Cornell through the Laboratory of Ornithology and the Education Department, where for years Richard Fischer, who received his Ph.D. under Allen, served as Professor of Environmental Education and continued his mentor's use of birds as an integral part of teaching science. Although science education continues at Cornell, there is currently no formal environmental or avian component to that program.

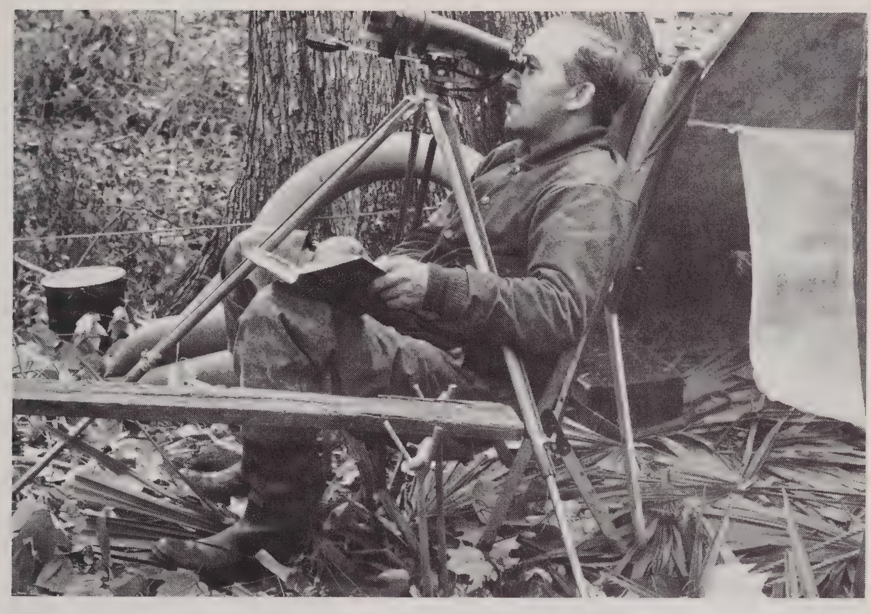

Fig. 8. Arthur A. Allen observing a nest of Ivory-billed Woodpeckers in northeast Louisiana in 1935.

LABORATORY OF ORNITHOLOGY

The name "Laboratory of Ornithology" had been used by Arthur Allen since 1915, but in 1956 (just before acquiring its new physical location) the name took on new meaning with the incorporation of the Laboratory as a department of Cornell University. Since he had retired as a professor, Allen established the Laboratory as a nonacademic department of the university. As such, the Laboratory has always raised more than 90% of its operating funds through memberships and other activities. Professionals at the Laboratory have acquired academic status through affiliation with academic departments on campus. Administrators at the Laboratory report both to the Cornell University administration and to an independent Administrative Board of the Laboratory.

The story of the founding of the Laboratory of Ornithology at Sapsucker Woods has been told many times (e.g., Fischer 1957, Allen 1962a,b; Harwood 1987). The key personalities were Arthur Allen, the educator, and Lyman K. Stuart, the philanthropist. Stuart wanted to learn to photograph birds, and Allen was happy to oblige. Stuart wanted to express his thanks, especially after winning first prize in a *Life* magazine photography contest. He bought most of Sapsucker Woods and paid for the building, called the Stuart Observatory since his death in 1965, that was built in 1956 and dedicated in a ceremony on 18 May 1957. There were five main sections to the original building: an aviary and offices for Dilger and his students, a darkroom and related space for photography, a recording studio for bird-sound recording, offices for staff and visiting ornithologists, and the observatory itself, with large windows overlooking the newly-dug pond. The Fuertes Room in the Brewster Wing was added to the structure and dedicated on 11 May 1968. The room features the murals that Fuertes painted for Frederick Foster Brewster in 1909 and the paneling from Brewster's study. In 1988, a major addition was added to the south end of the building to house the expanding Library of Natural Sounds and to provide room for the new Bioacoustics Research Program.

The preservation of Sapsucker Woods had been a goal of Allen's since he and Fuertes discovered a Yellow-bellied Sapsucker (*Sphyrapicus varius*) nest there in 1909. In 1949 and 1950, Allen and Oliver Owen conducted a detailed survey of breeding birds and vegetation of the eastern half of Sapsucker Woods (Owen 1950). In 1956, Allen instituted a breeding bird census for both halves of the woods. In 1979 and 1980, Thomas Litwin repeated the Owen study and found that many of the species present 30 years earlier had declined or disappeared (Litwin and Smith 1992), perhaps because of succession into mature forest and residential development surrounding the sanctuary. Mature forest covers about 50 ha of the 85-ha sanctuary.

For the first few years after the building of Stuart Observatory, Arthur A. Allen and Peter Paul Kellogg served as co-directors of the Laboratory. They were assisted by Sally Hoyt Spofford, a Cornell Ph.D., who provided administrative support for all of the Laboratory's projects from 1956 through 1969.

Olin Sewall Pettingill, Jr. was hired as Development Director for the Laboratory in 1960 and was promoted to Executive Director soon thereafter. Prior to coming to Cornell, Pettingill had taught at Carleton College in Minnesota for 17 years. While at Cornell, Pettingill continued to teach at the University of Michigan Biological Station in summers and taught there for a total of 35 years. Pettingill was both a successful book author and filmmaker and contributed greatly to the Laboratory's role of popularizing ornithology. Some films were used by Walt Disney studios; he showed others on the Audubon Screen Tours. He wrote a major ornithology textbook that appeared in five editions (Pettingill 1939, 1946, 1956, 1970, 1985), three major bird-finding guides (Pettingill 1951, 1953, 1965), and an autobiography of his formative years (Pettingill 1992).

Pettingill retired in 1973 and was succeeded as Executive Director by his Assistant Director, Douglas Lancaster, who served until 1979. Charles Smith was acting Executive Director until Charles Walcott was hired as

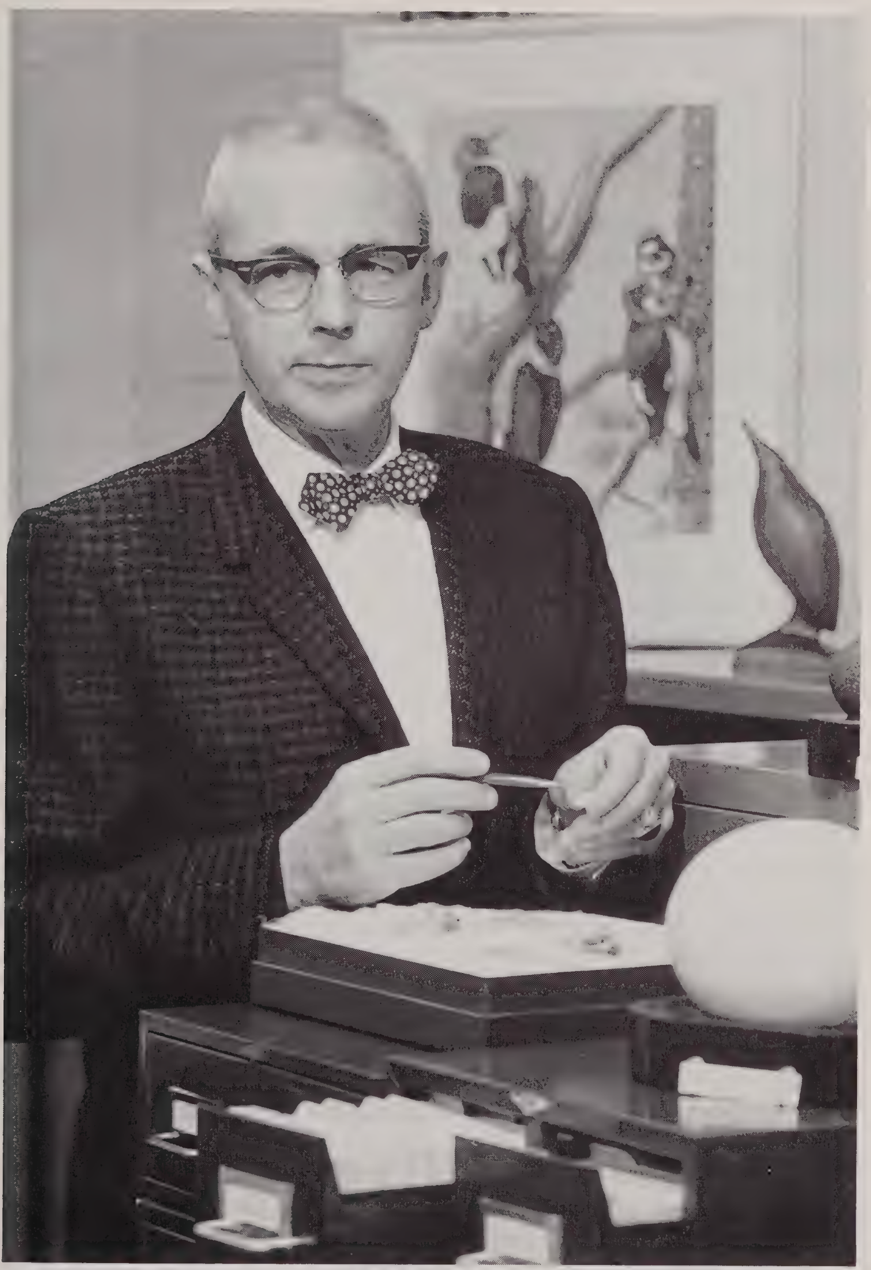

Fig. 9. Olin Sewall Pettingill, Jr., at the Laboratory of Ornithology in about 1960.

Executive Director in 1981. When Charles Walcott was named the Fuertes Director in 1993, with continuing responsibilities for research and education programs, Scott Sutcliffe became Executive Director.

In 1962 Cornell University hosted the 13th International Ornithological Congress, with many events held at the Stuart Observatory at Sapsucker Woods. About 650 ornithologists attended. Charles Sibley was Secretary-General of the Congress.

Arthur Allen died on 17 January 1964. Three years later the Laboratory initiated the Arthur A. Allen Award for individuals who have worked to widen popular interest in ornithology. The first award went to Roger Tory Peterson. Subsequent awards were made to: James Fisher (1968), George Miksch Sutton (1969), Alexander Wetmore (1970), Peter Scott (1971), Allan Cruickshank (1972), Oliver L. Austin, Jr. and Elizabeth S. Austin (1973), Olin Sewall Pettingill, Jr. (1974), Walter J. Breckenridge (1975), Joseph J. Hickey (1976), Jean Delacour (1977), Karl H. Maslowski (1978), Chandler Robbins (1979), William W. H. Gunn (1982), Alexander F. Skutch (1983), S. Dillon Ripley (1984), Robert S. Arbib, Jr. and Susan Roney Drennan (1985), Tom J. Cade (1988), Harold Mayfield (1990), and Crawford H. Greenewalt (1992).

In 1956 the Laboratory began publishing a newsletter for members. Ninety-nine issues of the newsletter were published from 1956 to 1982, when it was discontinued. *Birdscope*, the current research newsletter of the Laboratory, debuted in 1987.

In 1962 the Laboratory of Ornithology began publishing an annual journal, *The Living Bird.* The first volume was devoted to the Laboratory and research projects that were closely associated with it. Later volumes covered a wide variety of ornithological topics. The journal was noteworthy for the extensive and high-quality illustrations and for publishing longer articles with natural history information. Pettingill edited the first three volumes and co-edited the next eight volumes with Douglas Lancaster. Lancaster was editor for seven volumes; the last volume (number 19, 1982) was edited by Mary Clench.

The Living Bird was replaced by a full-color magazine, *The Living Bird Quarterly*, designed to appeal to a wider audience. Two issues of the quarterly appeared in 1982; they included a short News and Notes section about the Laboratory, a Research and Review section with short synopses of recently published scientific papers, and longer articles on ecology, behavior, and bird conservation. The title was shortened to *Living Bird* in 1991.

Arthur Allen's interest in bird photography led to the creation of a slide collection at the Laboratory. Currently, the Laboratory maintains a commercial collection of color slides of North American birds by a variety of photographers.

In the late 1930s, Peter Paul Kellogg inaugurated a 15–minute weekly radio program, “Know Your Birds,” that continued in the Ithaca area until 1989. At that time the local program was replaced by a nationally distributed 90–second program called *BirdWatch*, which at one time reached more than 125 radio stations in North America.

In 1972 Olin Sewall Pettingill, Jr. initiated a home study course in bird biology. Chapters were written by a variety of experts and edited by Pettingill and Douglas Lancaster. Twenty years (and minor revisions) later, the course is still offered. During the 1980s, the Laboratory also offered a home study course in bird photography.

In 1963, the Laboratory began the Nest Record Program to engage volunteers in collecting useful information on the status of bird populations. The program was started by David Peakall, a British native who was studying the effects of environmental contaminants on the breeding biology of falcons (Peakall 1969, 1970). It was modeled on the Nest Record Scheme in his native Great Britain. Peakall started the program at the time when the effects of DDT and other chlorinated hydrocarbons were first being understood, and he thought that the Nest Record Program could provide evidence of birds failing to reproduce at levels sufficient to maintain stable populations. The program required repeated visits to bird nests, with data reported on cards designed for computer entry. More than 300,000 cards of more than 550 species have accumulated, mostly from the 49 continental United States. Observers continue to submit cards, although there is currently little promotion or funding for the program.

In 1975 Donald McCrimmon was hired to begin the Colonial Bird Register, a joint project of the Laboratory and the National Audubon Society, with support from the U.S. Fish and Wildlife Service. The register included information on visits to bird colonies during the breeding season. Species coverage included primarily pelicans, cormorants, herons, egrets, ibises, gulls, and terns. The register included data from colony surveys from Maine through Florida coordinated by the U.S. Fish and Wildlife Service in 1976 and 1977 (Erwin and Korschgen 1979, Portnoy et al. 1981), from Texas surveys 1973–80 (Texas Colonial Waterbird Society 1982), and from a variety of other statewide surveys. The register was suspended in 1988 because of insufficient financial support to insure high quality data.

In 1978 the Laboratory hosted a conference on the amateur and North American ornithology that was co-sponsored by the National Audubon Society (McCrimmon and Sprunt 1979). The conference brought together a number of organizations that worked with volunteers to collect bird information and discussed better ways to organize future projects.

In 1984 Gregory Butcher came to the Laboratory and became Director of Bird Population Studies, integrating the Nest Record Program, Colonial Bird Register, and computerized Audubon Christmas Bird Counts, analyzing longterm population trends, and studying the effects of agricultural practices on bird populations. Later projects included Project FeederWatch and the National Science Experiments. In 1993 Butcher left the Laboratory and was replaced by Kenneth Rosenberg, who began his career as a Cornell undergraduate.

In 1986 Erica Dunn came to the Laboratory and suggested a continent-wide survey of birds at birdfeeders. She was about to start the tenth year of the Ontario Birdfeeder Survey and was curious about birds at birdfeeders in other parts of the continent. In the winter of 1987–88, Project FeederWatch was initiated with 4000 participants. In subsequent years, about 8000 people have participated. The project has documented bird feeder use for eight regions of North America, the irruptions of Pine Siskins (*Carduelis pinus*), Common Redpolls (*Carduelis flammea*), Red-breasted Nuthatches (*Sitta canadensis*), and other species, and backyard habitats and their effects on birds at feeders.

Two special projects were conducted as part of Project FeederWatch. First, "Project DeathWatch" documented predation by cats, Sharp-shinned Hawks (*Accipiter striatus*), other raptors, and many other species; window-kills; and disease, primarily salmonellosis. Second, a bird seed preference survey documented bird use of more than 50 different kinds of food.

In 1992 the Laboratory received a three-year grant from the National Science Foundation to launch three National Science Experiments. Volunteers will collect data to answer questions about bird seed preferences, breeding tanagers in forest fragments, and the breeding seasonality of feral pigeons.

In 1992 the Laboratory endowed two positions: the Louis Agassiz Fuertes Directorship of the Laboratory of Ornithology, now held by Charles Walcott, and the Edwin H. Morgens Professor of Ornithology, now held by André Dhondt. These positions augur well for the future of the Cornell Laboratory of Ornithology and suggest that the Laboratory will have close academic ties with other departments at Cornell University.

ACKNOWLEDGMENTS

This chapter was expanded from a talk given at the March 1991 Association of Field Ornithologists' meeting in Ohio. William E. Davis, Jr., and Jerome Jackson, who served as conveners of the symposium and editors of this volume, have been very helpful and supportive throughout. Richard E. Bonney, Jr., and Gregory F. Budney, co-authors of the talk, provided information about the Laboratory of Ornithology and bird song recording, respectively. We thank William C. Dilger, Howard E. Evans, James D. Lowe, Dorothy McIlroy, Kenneth C. Parkes, Sewall Pettingill, Sally Hoyt Spofford, and Scott Sutcliffe, each of whom read drafts of this manuscript and made very helpful suggestions. Photographs for figures 1–9 are courtesy of the Division of Rare and Manuscript Collections, Carl A. Kroch Library, Cornell University, Ithaca, New York.

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APPENDIX I.

Graduate Theses, Dissertations and Nonthesis Master's at Cornell University Concerning Birds

* denotes specimens in Cornell collection used in thesis work.
[1] denotes Ph.D. dissertation.
[2] denotes Master's thesis.
[3] denotes non-thesis Master's Degree in ornithology.

1911	Allen, A. A. The Red-winged Blackbird: a study in the ecology of a cattail marsh.[1]
1915	Griscom, L. The identification of the commoner Anatidae of eastern United States in the field.[2]
1923	*Friedmann, H. The cowbirds: a contribution to the study of parasitism in birds.[1]
1925	*Danforth, S. T. An ecological study of Cartagena Lagoon, Porto Rico with special reference to the birds.[1]
	Harper, F. A faunal reconnaissance in the Athabaska and Great Slave Lake region.[1]
	*Smyth, T. Studies in the life history of the Ruffed Grouse.[1]
1926	Knappen, P. M. A census of the birds nesting on the Cornell campus in 1926 compared with a similar census made in 1913.[2]
	*Leffingwell, D. J. A study of the pheasant *Phasianus colchicus* L. with notes on its artificial propagation.[1]
	Odell, T. T. The food of orchard birds with special reference to the Pear Psylla.[2]
1927	Pickwell, G. B. The Prairie Horned Lark.[1]
1928	*Pirnie, M. D. The plumage changes of certain water fowl.[1]
1929	Butts, W. A study of the chickadee and White-breasted Nuthatch by means of marked individuals.[1]
	Haldeman, D. W. A study of the Song Sparrow, *Melospiza melodia.*[2]
	*Leister, C. W. Food and feeding habits of the ducks of the Cayuga Lake region.[1]
	*Lewis, H. F. The natural history of the Double-crested Cormorant (*Phalacrocorax auritus auritus* (Lesson)).[1]
1930	Compton, D. M. A study of the Downy Woodpecker *Dryobates pubescens medianus.*[2]
	Edminster, F. C., Jr. A study of ornithological terms in common use.[2]
1931	*Crouch, J. E. A study of the Cedar Waxwing *Bombycilla cedrorum* Vieillot.[2]

1932 *Gould, V. E. A history of the Bob-white in New York State with particular reference to restocking.[2]

Hering, P. E. A study of the food habits of the Crow (_Corvus brachyrhynchos brachyrhynchos_ Brehm) in central New York state.[1]

*Kingsbury, E. W. A study of the Hairy Woodpecker.[2]

*Rand, A. L. The distribution and habits of Madagascar birds.[1]

*Saunders, G. B. A taxonomic revision of the meadowlarks of the genus _Sturnella_ Vieillot and the natural history of the Eastern Meadowlark _Sturnella magna magna_ (Linnaeus).[1]

*Sutton, G. M. The birds of Southampton Island, Hudson Bay.[1]

*Welter, W. A. The natural history and taxonomy of the Marsh Wren _Telmatodytes palustris_ (Wilson).[1]

1933 Cope, T. M. Some observations on the vertebrate ecology of a Pennsylvania mountain farm.[2]

Hunter, R. P. The early development of the hypoglossal musculature in the chick.[1]

Kingsbury, E. W. The status and natural history of the Bobolink _Dolichonyx oryzivorus_ (Linnaeus).[1]

*Pettingill, O. S., Jr. The American Woodcock _Philohela minor_ Gmelin.[1]

Smyth, J. A. The literature of the Virginia Rail.[2]

*Vijjakich, L. S. A study of a bird collection from Siam.[2]

1934 Emlen, J. T., Jr. The roosts and night-roosting of birds.[1]

Beyer, L. K. A study of the Bank Swallow _Riparia riparia_ (Linn.).[2]

1935 Elmore, L. J. A study of the sexual behavior of Ruffed Grouse (_Bonasa umbellus_ Linn.).[2]

*Happ, G. B. A study of the Flicker (_Colaptes auratus_ (Linnaeus)).[2]

Harrower, D. E. The habits of the passerine birds of Central America, with particular reference to their breeding.[1]

*Heydweiller, A. M. Life history of the Tree Sparrow (_Spizella arborea_).[1]

Robinson, M. Z. A comparison of perching mechanisms in birds.[2]

Test, F. H. Bird weight and its significance.[2]

1936 Bate, R. C. The development of the epiphysis in the common fowl (_Gallus domesticus_) with reference to its histology.[2]

Cope, T. M. Observations on the vertebrate ecology of some Pennsylvania virgin forests.[1]

Gordon, K. L. The application of the laboratory type of experiment to field studies of the behavior of chipmunks, winter birds, and some nesting birds.[1]

*Johnson, R. A. A study of the life history of the Atlantic Murre *Uria aalge aalge.*[1]

Tanner, J. T. Sound recordings for a natural history museum.[2]

1937 *Baumgartner, F. M. A study of the American horned owls (*Bubo virginianus*).[1]

Benson, D. Studies in the ecology of the Black Duck *Anas rubripes* Brewster.[2]

Phillips, V. A. A study of *Spinus tristis tristis* with special reference to the breeding habits at Ithaca, New York.[2]

1938 *Arnold, J. R. The systematic position and natural history of the Northern Blue Jay *Cyanocitta cristata bromia* Oberholser.[1]

*Coles, V. Studies in the life history of the Turkey Vulture (*Cathartes aura septentrionalis* Wied).[1]

Edeburn, R. M. A study of the distribution of breeding birds in a typical upland area.[1]

Kellogg, P. P. A study of bird sound recording.[1]

*Kelso, L. H. A study of the Screech Owl (*Otus asio*).[2]

Myers, F. R. A biological reconnaissance of Somerset County, New Jersey.[2]

Rankin, W. H. The life history and distribution of the Chipping Sparrow *Spizella passerina passerina* (Bech.).[2]

*Trainer, J. E. The pterylography of the Ruffed Grouse.[2]

*Weaver, F. G. The life history of the Wood Thrush (*Hylocichla mustelina* Gmelin).[2]

1939 *Barbour, R. W. The life history of the Red-eyed Towhee (*Pipilo erythrophthalmus erythrophthalmus*).[2]

Benson, M. K. H. A study of the American Redstart (*Setophaga ruticilla* Swainson).[2]

1940 Becker, E. E. A study of the Brown Thrasher *Toxostoma rufum* (Linnaeus).[2]

*Howell, J. C. A study of the American Robin (*Turdus migratorius* Linnaeus).[1]

Hoyt, J. S. Y. A study of the Pileated Woodpecker *Ceophloeus pileatus* (Linnaeus).[2]

*Kutz, H. L. Studies on the inhibiting influence of captivity upon reproduction in wild ducks. Effect of light and various gonadotropic hormones.[1]

*Palmer, R. S. A behavior study of the Common Tern *Sterna hirundo* Linnaeus.[1]

Petrides, G. A. A study of hedgerows in winter and their relation to wildlife in central New York state.[2]

*Tanner, J. T. The life history and ecology of the Ivory-billed Woodpecker.[1]

1941 Cassel, J. F.[3]

Deller, W. M. The development of the thyroid in the chick.[2]

Dudley, J. The development and fate of the ultimobrachial body of the common fowl, *Gallus domesticus*.[1]

Edwards, E. P. Frequency range of auditory responses in several species of captive wild birds.[2]

Hewitt, O. H. A study of the ecology of an artificial fresh-water marsh with special reference to ducks and muskrats.[2]

*Kenyon, K. W. A study of the old nest as a visual stimulus to re-nesting in the Baltimore Oriole, *Icterus galbula* (Linnaeus), including supplementary life history observations.[2]

*Loetscher, F. W., Jr. Ornithology of the Mexican state of Veracruz with an annotated list of the birds.[1]

*Merry, K. A study in the life history of the Eastern Phoebe *Sayornis phoebe* (Latham).[1]

Penix, D.[3]

*Webster, J. D. A study of the Black Oystercatcher *Haematopus bachmani* Aud.[2]

1942 Dehner, E. W. L. Studies on avian morphology: the shoulder and wing of the Rock Pigeon (*Columba livia*) and Ground Dove (*Columbigallina passerina*).[2]

*Wanamaker, J. F. A study of the courtship and nesting of the Eastern Cardinal *Richmondena c. cardinalis* (Linnaeus).[2]

1943 *Fagley, M. L. Birds of the Lower Rio Grande Valley of Texas.[2]

*Grinnell, L. I. A study of the Common Redpoll *Acanthis linaria linaria* Linnaeus.[2]

Muirhead, P.[3]

Stevenson, H. M., Jr. The winter distribution of land birds in the southeastern states.[1]

Turner, R. Progress report on study of the subspecies of *Empidonax traillii*.[2]

1944 Hewitt, O. H. Waterfowl food plants and the duck population at the head of Cayuga Lake.[1]

Montagna, W. A re-investigation of the development of the wing of the fowl.[1]

Moser, R. A preliminary check-list of the birds of Idaho.[2]

1946 Dehner, E. W. L. An analysis of buoyancy in surface-feeding and diving ducks.[1]

Folger, E. V. The birds of Nantucket.[2]

*Phillips, A. R. The birds of Arizona.[1]

	Trainer, J. E., Jr. The auditory acuity of certain birds.[1]
1947	Axtell, H. H. The distribution of the vertebrate animals of Chemung and Schuyler Counties, New York.[1]
	*Bibbee, P. C. The Bewick's Wren (*Thryomanes bewickii* (Audubon)).[1]
	Buchanan, F. W.[3]
	*Grinnell, L. I. A study of the Common Redpoll *Acanthis flammea flammea* (L.) in comparison with other North American species of the genus *Acanthis.*[1]
	Parkes, K. C. A survey of published colored illustrations of North American birds.[2]
	*Warner, D. W. The ornithology of New Caledonia and the Loyalty Islands.[1]
	Westfall, M. J., Jr. A preliminary biological survey of a central New York woodlot with special reference to its use to naturalists and in the training of naturalists.[1]
1948	Bump, N. G. Wildlife habitat changes on the Connecticut Hill Game Management Area over a twenty-year period and their effect on certain species of wildlife.[1]
	Cameron, A. W. Game populations in Nova Scotia.[2]
	*Hoyt, J. S. Y. Further studies of the Pileated Woodpecker *Hylatomus pileatus* (Linnaeus).[1]
	Hoyt, S. F. A reference book and bibliography of ornithological techniques.[1]
1949	Amadon, A. D. The Hawaiian honeycreepers (family Drepanididae).[1]
	Benton, A. H. The breeding birds of Cayuga County, New York.[2]
	*Eaton, S. W. The genus *Seiurus*; a comparative study of the species.[1]
	*Edwards, E. P. Birds of the Patzcuaro Lake Basin.[1]
	*Fetherston, K. E. A study of the Ring-necked Pheasant on Pelee Island, Ontario.[1]
	Gollup, J. B.[3]
	Grube, G.[3]
1950	*Hawksley, O. H. A study of the behavior and ecology of the Arctic Tern, *Sterna paradisaea* Brunnich.[1]
	Lamore, D.[3]
	Owen, O. S. The bird community of an elm-maple-ash swamp in central New York.[1]
1951	Dilger, W. C. An introduction to the ornithology of India including a bibliography.[2]

Hensley, M. M. Ecological relations of the breeding bird population of the desert biome in Arizona.[1]

*Kessel, B. Investigation on the life history and management of the European Starling (*Sturnus vulgaris vulgaris* L.) in North America.[1]

Lee, J. A. A study of the waterfowl resources in the capitol district region, New York.[2]

Lewis, P. D. A partial gazeteer of South American collecting localities.[2]

*Meng, H. K. The Cooper's Hawk *Accipiter cooperii* (Bonaparte).[1]

Smith, L. S. A game survey of the Arnot Forest with emphasis on grouse and deer.[2]

1952 *Barbehenn, K. R. Farm fishponds, filamentous algae and Mallard Ducks.[2]

Curtis, W. E. Quantitative studies of echolocation in bats (*Myotis l. lucifugus*); studies of vision of bats (*Myotis l. lucifugus* and *Eptesicus f. fuscus*); and quantitative studies of vision of owls (*Tyto alba pratincola*).[1]

*Parkes, K. C. The birds of New York state and their taxonomy.[1]

Watts, G. E. Life history of the Rose breasted Grosbeak (*Hedymeles ludoviciana*).[2]

1953 Adams, H. P. A summer survey of deer and grouse in the Arnot area.[2]

Carpenter, M. M. Wood Duck production and life history on the Montezuma National Wildlife Refuge, New York, 1952.[2]

*Cooch, F. G. A preliminary study of Blue and Lesser Snow Geese on Southampton Island.[2]

*Fischer, R. B. Studies in the breeding biology of the Chimney Swift *Chaetura pelagica* (Linnaeus).[1]

*Goodwin, R. E. A study of the breeding behavior of the Black Tern, *Chlidonias niger surinamensis*.[2]

Hartshorne, J. M.[3]

Rawson, K. S. Studies of orientation in the Starling (*Sturnus vulgaris* L.).[2]

1954 Johnson, H. M. Winter microclimates of importance to Alaskan small mammals and birds.[1]

Myers, R. F. A study of duck brood production on some new York state small marshes.[2]

Reilly, E. M., Jr. Origins and distributions of North American birds.[1]

Simon, S. W. A comparative study of the nesting birds in the Cranberry Glades, West Virginia.[2]

Stein, R. C. Sound patterns of the Alder Flycatcher, *Empidonax trailii* (Audubon): a preliminary study.[2]

Wolk, R. G. Some preliminary observations on the reproductive behavior of the Least Tern *Sterna albifrons antillarum* (Lesson).[2]

1955 Burnett, F. L. The application of sound recording to museum natural history exhibits.[1]

*Dilger, W. C. Ecological isolating mechanisms, reproductive isolating mechanisms and relationships of the avian genera *Hylocichla* and *Catharus.*[1]

Hull, D. E. The use of artificial nesting sites by dabbling ducks.[2]

Klein, H. G. Wood Duck production on some small marshes in New York State.[2]

1956 Caswell, H. H. The application of measures of association to analysis of ecological relationships among birds.[1]

1957 *Peters, S. S. Food habits of the Newfoundland Willow Ptarmigan.[2]

*Stein, R. C. The behavioral, ecological and morphological characteristics of two populations of the Alder Flycatcher *Empidonax traillii* (Audubon).[1]

1958 *Cooch, F. G. The breeding biology and management of the Blue Goose *Chen caerulescens*.[1]

Fink, B. A. The effect of capture and caging on the thyroid activity of English Sparrows (*Passer domesticus*).[2]

1959 *Johnsgard, P. A. Evolutionary relationships among the North American Mallards.[1]

*Short, L. L., Jr. Hybridization in the flickers (*Colaptes*) of North America.[1]

*Sibley, F. C. Hybridization in the red-eyed towhees of eastern Mexico.[2]

*West, D. A. Hybridization in the North American grosbeaks, genus *Pheucticus.*[1]

Wolk, R. G. Some reproductive behavior patterns of the Black Skimmer, *Rynchops nigra nigra* Linnaeus.[1]

1960 *Barry, T. W. Breeding biology of the Atlantic Brant (*Branta bernicla hrota*).[2]

Ficken, M. S. Behavior of the American Redstart, *Setophaga ruticilla* (Linnaeus).[1]

Ficken, R. W. Behavior of the Common Grackle, *Quiscalus quiscula* (Linnaeus).[1]

*Goodwin, R. E. A study of the ethology of the Black Tern, *Chlidonias niger surinamensis* (Gmelin).[1]

MacInnes, C. D. The Canada Geese (*Branta canadensis*) of the McConnell River.[2]

1961	Adams, H. P. A study of rate of ossification in Passeriformes from the time of hatching to the time of fledging.[1]
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10

History of Ornithological Research Within the United States Forest Service

Richard N. Conner[1]

ABSTRACT.— The United States Forest Service was first established as a forest reserve system for the scientific management and conservation of federal forested lands with the Forest Reserve Act of 1891. The research arm of the U.S. Forest Service was established by Gifford Pinchot in 1908. Initial research was primarily directed toward reforestation problems and descriptions of different tree species. Recognition of the importance of vertebrates as components of National Forests, and of research to gain a better understanding of species' requirements, began mainly during the 1940s. The earliest Forest Service studies and syntheses of knowledge on birds also began in the 1940s with game species receiving initial attention. Only in the 1970s did the paucity of information on the habitat and management needs of what became known as nongame birds begin to receive major Forest Service emphasis. In the 1980s the Forest Service's research commitment toward threatened and endangered birds increased markedly. The beginning of the 1990s saw an emerging emphasis on neotropical migrant birds. During the 1970s the Forest Service began to employ more doctoral level scientists as ornithologists, whereas previously most Forest Service scientists had master's degrees. Historically, most research wildlife biologists had primarily a wildlife and forestry background. During the 1970s and 1980s newly hired doctoral level scientists had more varied educations, frequently in ecology, zoology, or evolutionary biology. This period also saw more women hired as research biologists to study birds.

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ESTABLISHMENT AND EARLY HISTORY OF THE U.S. FOREST SERVICE

The large scale disappearance of forests and lack of reforestation throughout the United States during the late 1800s caused great concern for many conservationists and preservationists (Steen 1991). In 1873, Dr. Franklin B. Hough, a physician who was concerned about loss of forest habitat, presented a paper before the American Association for the Advancement of Science urging that some of the remaining virgin forested lands be preserved for their value as watersheds and other resource needs (USDA 1989). A committee of scientists drafted and submitted a report to President Ulysses S. Grant that expressed the need for the establishment of a Federal commission to examine the rapid exhaustion of the nation's timber supply. In 1876 Congress requested that Dr. Hough make a study of forestry needs and in 1881 he became Chief of a newly created Division of Forestry within the U.S. Department of Agriculture (USDA).

Bernhard E. Fernow, a German forester and perhaps the first practicing trained forester in North America, played a critical role on the committee that requested Congress and the President to establish a system of forest reserves. The Forest Reserve Act of 1891 permitted the establishment of the federal forest reserves that became the present National Forest System (Steen 1991). Fernow served as Chief of the Forestry Division in the Department of Agriculture until 1898 (Rodgers 1951). He wrote the original draft of the bill that was submitted to Congress by the American Forestry Association and later became the Organic Act of 1897. Fernow was a strong advocate of research and had always supported technical and theoretical forestry.

Gifford Pinchot also contributed to the conceptual development and establishment of the Forest Reserve System. Following the lead of Fernow, he strongly supported research within the Division of Forestry. Although Hough and Fernow conducted some of the earliest investigations, Pinchot established the first official Section on Special Investigations in 1898 (Pinchot 1947). By 1902 the research arm had expanded to 55 employees and was elevated to Division of Forest Investigation. Pinchot became the first chief of the new U.S. Forest Service in 1905 and served in that capacity until 1910 (USDA 1991). Pinchot thought of the Forest Reserve System as a means to preserve and protect some forest lands in United States from exploitation by big timber barons. The 1897 Act had given the newly created Forest Service the right to sell "dead, matured, or large growth of trees," and Pinchot favored the use of local sawyers to accomplish the harvesting. The prime objective of the forests was use, but use had to be justified and not contribute to over-cutting or injury to young trees that was often done by the big timber companies of the time (Pinchot 1947). "Use" also would be scientifically based, and needed a research organization to create the scientific rudder.

On 11 December 1907 Pinchot directed Raphael Zon to develop a scheme for establishing forest experiments on National Forests. By 6 May 1908 Zon presented Pinchot a plan that was to serve as the charter for creating the Forest Experiment Stations of the present day (Zon 1908). The first of many field research stations was established in Fort Valley, Arizona in 1908. Henry S. Graves, Chief of the Forest Service in 1915, established the Branch of Research that gave Forest Service research its independence from the administrative and management branch overseeing the National Forests.

By the 1920s there were 12 regional research stations with branch experiment stations (Steen 1977). In 1924 the Society of American Foresters expressed concern that Forest Service research did not have unifying legislation and congressional support, and the McSweeney-McNary Research Act of 1928 was passed by Congress to provide legislative support for Forest Research Experiment Stations, authorize research on a broad scale, and provide appropriated funds for research (Steen 1977).

Aldo Leopold began his professional career in the U.S. Forest Service in 1909. By 1924 he was Associate Director of the Forest Service's Forest Products Lab in Madison, Wisconsin. Much of Leopold's field work and studies dealt with birds. Later, Leopold accepted a Chair in game management at the University of Wisconsin. He is best known for his book on game management and *A Sand County Almanac* (Leopold 1933, 1949).

EARLY ORNITHOLOGICAL RESEARCH IN THE U.S. FOREST SERVICE

Early research emphasis: 1920–1940s.—Initial research within the U.S. Forest Service emphasized reforestation, dendrology, mensuration, protection, management, and product development (Clapp et al. 1920). Early research on vertebrates in the 1920s was directed at prevention of coyote (*Canis latrans*) predation on sheep as part of a range research program. The few studies of wildlife that were conducted in the early days of the U.S. Forest Service were largely accomplished by funding researchers in universities and other agencies.

An early reference to U.S. Forest Service interest in birds appears in the 1930s in a national plan for American forestry (Roberts 1933). Paul H. Roberts, writing for the Secretary of Agriculture, was particularly concerned that forest mammals and birds were being increasingly restricted to the remaining patches of forest as forest industry and agriculture advanced westward. He recognized that many species of birds were dependent on forested lands for all or some of their life requirements. Characteristic of the early days of the Forest Service, concern was expressed mainly for game mammals and occasionally game birds, in this instance degradation of quail habitat caused by overgrazing.

Research sponsored or conducted on quail by the U.S. Forest Service in the Pacific Southwest Station appears to have first started in the 1930s with Glading's (1938a,b) study of nesting behavior of the California Quail (*Callipepla californica*) on the San Joaquin Experimental Range. Glading described courting and nesting behavior, nesting cover, clutch size, and predator relationships.

The Southern Forest Experiment Station may have been the first to sponsor research on nongame birds. Burleigh (1938) examined the impact of bird consumption of longleaf pine (*Pinus palustris*) seeds on reforestation efforts in the South. He examined stomach contents of the American Robin (*Turdus migratorius*), Eastern Meadowlark (*Sturnella magna*), Mourning Dove (*Zenaida macroura*), Northern Bobwhite (*Colinus virginianus*), and four species of blackbirds.

During the 1940s sponsorship and funding for research on California Quail on the San Joaquin Experimental Range continued with emphases on census methods, diet (Glading et al. 1940), effects of hunting (Glading and Saarni 1944), and diseases (Herman et al. 1942, Herman and Chattin 1943). The Pacific Southwest Station also supported research on raptors during the 1940s. Observations on nesting Great Horned Owls (*Bubo virginianus*) (Fitch 1940), Cooper's Hawk (*Accipiter cooperii*) nesting and predation (Fitch et al. 1946a), and an outstanding paper on Red-tailed Hawk (*Buteo jamaicensis*) ecology and behavior (Fitch et al. 1946b) were based on research on the San Joaquin Experimental Range and supported in part by the U.S. Forest Service.

Ornithology in the Forest Service: 1950s and 1960s.—Research emphasis on birds within the U.S. Forest Service did not change much following World War II. Information needs perceived by the National Forest System (NFS) were still largely oriented toward game species. C. O. Lindh (1957), the Regional Forester for the southern region, saw a need for large scale studies on wildlife-forest relationships. He foresaw increased hunting and fishing demand and sought information to help increase Wild Turkey (*Meleagris gallopavo*) populations. Lindh's interest was echoed by Shaw (1959) and Wentz and Hardy (1959). Shaw (1959) urged examination of the Wild Turkey's need for mature forest habitat in a paper outlining U.S. Forest Service Wild Turkey management plans in the southern region.

U.S. Forest Service support for research on raptors on the San Joaquin Experimental Range continued into the 1950s. Cohen (1951) reported on California Condors (*Gymnogyps californianus*) on the Experimental Range. Childs (1952) observed an American Kestrel (*Falco sparverius*) prey on a nocturnal kangaroo rat.

In 1960 Congress passed the Multiple Use-Sustained Yield Act which re-emphasized the U.S. Forest Service policy that recognized wildlife as a product of the forest, providing further endorsement and strength for wildlife-habitat investigations (Segelquist and Halls 1967). Interest in Northern Bobwhite and Wild Turkey increased within the Forest Service during the 1960s in the southeast, especially from scientists within the Southern Forest Experiment Station in Nacogdoches, Texas. During the 1960s, emphasis on habitat needs for Wild Turkey on National Forests increased (Segelquist and Halls 1967). The major focus of avian studies in the southeast continued to be dominated by Northern Bobwhite and Wild Turkey (Johnson et al. 1961, Halls 1962). Devet and Hopkins (1968) examined the effects of prescribed burning on quail and turkey food plants. Stransky and Halls (1968) evaluated potential responses of Northern Bobwhite and Wild Turkey to predicted trends in timber management of public and private lands.

Research on California Quail on the San Joaquin Experimental Range continued in the 1960s with support from the Pacific Southwest Forest Experiment Station. Duncan (1968), and Shields and Duncan (1966) continued studies of quail food requirements and the effects of burning on quail food production.

In the late 1960s an awareness of the need for information on nongame birds began to grow. Hooper and Crawford (1969), at the Southeastern Forest Experiment Station in Blacksburg, Virginia, noted that the public was spending considerable funds on watching and photographing birds in a nonconsumptive use of wildlife and that nongame woodland birds were sensitive to habitat changes within forests and were affected by forest management activities, particularly timber cutting. They summarized some existing information and outlined some research approaches for studying birds in forest habitats.

During 1968 Frank Wadsworth, Director of the U.S. Department of Agriculture's Institute for Tropical Forestry in Rio Piedras, and Raymond Erickson, Assistant Director of the U.S. Fish and Wildlife Service's Patuxent Wildlife Research Center, began a long-standing Forest Service commitment for research on the Puerto Rican Parrot (*Amazona vittata*) (Snyder et al. 1987).

The 1960s saw the U.S. Forest Service's first real involvement with efforts to conserve and maintain habitat for the Kirtland's Warbler (*Dendroica kirtlandii*). After years of intensive efforts, Harold Mayfield convinced personnel in the supervisor's office of the Huron National Forest to establish a management area and develop a management plan for the Kirtland's Warbler. On 1 June 1963, Edward Cliff, Chief of the U.S. Forest Service, went to Michigan and participated in the dedication of a 1620 ha Kirtland's Warbler Management Area east of Mack Lake, on the Huron National Forest (Mayfield 1963). The management plan for the area had been approved in July 1962 and included the cutting and controlled burning recommended by Harold Mayfield on 12 management blocks of about 130 ha each.

THE RENAISSANCE OF NONGAME BIRD RESEARCH IN THE FOREST SERVICE

A major expansion of nongame bird research: 1970s.—During the 1970s, research concerning avian habitat requirements and management needs increased within the Forest Service's research branch and through the Forest Service's funding of research at universities. Much of the ornithological research conducted by the Forest Service was directed toward determining the impacts of forest management and timber harvesting on birds. Because of the enormous amount of work sponsored and funded by the U.S. Forest Service and space constraints of this paper, I will mainly focus on avian research and other contributions to ornithology made by U.S. Forest Service employees. Forest Service financial support for avian research at universities around the United States during the 1970s and up to present times has been substantial and deserves note.

Prior to the 1970s, most Forest Service researchers had been males with a bachelor's or master's degree in wildlife management. In the mid- and late 1970s newly hired researchers who studied birds typically held a doctorate, and quite often had an ecology, zoology, or evolutionary biology background. This diversified the Forest Service research team and added new insights into conflicts between timber production and wildlife resources. The new ornithological researchers also typically had a more quantitative background and were more often familiar with computers and statistics. This trend became even more pronounced in the 1980s.

Game bird research.—The 1970s saw continued research on game birds but a reduction in emphasis relative to nongame birds. In the Northeastern Forest Experiment Station, William Healy studied Wild Turkey imprinting behavior, wintering habitat, and feeding activity of poults relative to ground vegetation and insect abundance (Healy 1977, Healy et al. 1975). Healy and Jack Ward Thomas also studied the effects of dusting on quail plumage (Healy and Thomas 1973). John Gill evaluated the quality of seven forest types for Wild Turkey and Ruffed Grouse (*Bonasa umbellus*) in West Virginia (Gill et al. 1975).

At the Southeastern Forest Experiment Station, William Moore (1972) studied the management needs of Northern Bobwhite in cut-over pine lands of south Florida. John Stransky (1971) studied Northern Bobwhite management in longleaf pine forests for the Southern Forest Experiment Station. Newman and Duncan (1973) reported on all vertebrate fauna on the San Joaquin Experimental Range in California. Keith Evans and Donald Dietz examined winter nutritional energetics of Sharp-tailed Grouse (*Tympanuchus phasianellus*; Evans and Dietz 1974).

Research on endangered species in the 1970s.—During the 1970s Congress passed several bills that had a significant impact on the study and management of birds by the U.S. Forest Service. Federal classification of species as threatened or endangered began in the late 1960s and continues. Legal teeth were given to this classification with the passage of the Endangered Species Act of 1973 which made management of endangered species an important component of the National Forest System's responsibility. The earliest Forest Service effort to study Red-cockaded Woodpeckers (*Picoides borealis*) produced descriptive data for the distribution of the woodpecker in South Carolina and on the Francis Marion National Forest (Hopkins and Lynn 1971). Hopkins and Lynn also examined characteristics of forest stands and cavity trees used by the woodpecker and participated in the first Red-cockaded Woodpecker symposium at the Okefenokee National Wildlife Refuge in Folkston, Georgia, in May 1971.

In 1974 the Southeastern Forest Experiment Station opened a research laboratory in Clemson, South Carolina, that had a primary responsibility within the Forest Service for studying habitat needs of Red-cockaded Woodpeckers. Richard Harlow, Robert Hooper, and Michael Lennartz moved to the newly established research lab. Working with Lennartz and Hooper, Jerome Jackson (Mississippi State University) examined the age of pines in which Red-cockaded Woodpeckers initiated cavities (Jackson et al. 1979). Richard Conner began studies on Red-cockaded Woodpecker cavities, nesting habitat, and fire with the Southern Forest Experiment Station in 1977 (Conner and Locke 1979).

Research on the Puerto Rican Parrot continued on the Luquillo Experimental Forest in Puerto Rico. Cameron Kepler (U.S. Fish and Wildlife Service) was assisted by Michael Lennartz during breeding season studies in 1971 and 1972. During late 1976, James Wiley, who had been studying the Hispaniolan Parrot (*Amazona ventralis*), left the U.S. Forest Service to join the U.S. Fish and Wildlife Service's Patuxent team and took over direction of the Puerto Rican Parrot research when Noel Snyder left (Snyder et al. 1987). Sartor Williams joined the research effort on the parrot as the U.S. Forest Service's lead during June 1979, but stayed only through June 1980.

Forest management legislation: multiple use, and viable populations.—In 1974 Congress passed the Forest and Rangeland Renewable Resources Planning Act (RPA), which was later amended by the National Forest Management Act of 1976. The National Forest Management Act required balanced consideration of all forest resources, maintenance of viable populations of native vertebrate species, and improvement of forest habitat for indicator species (Dickson et al. 1984). Both bills created a major information need within the U.S. Forest Service. Rather than managing for just specific game species and species recently designated threatened or endangered, the Forest Service was now also required by law to know the habitat and management needs of 400 to 1200 additional vertebrate species and to monitor species to ensure that viable populations were being maintained.

Shaping the future of Forest Service ornithology.—The Forest and Rangeland Renewable Resources Research Act of 1978 replaced the McSweeney-McNary Act of 1928 and directed that research be conducted on how forests and rangelands should be managed for wildlife, improving wildlife habitat, and protection of threatened and endangered species. This, in essence, expanded the Forest Service's research responsibility to include all bird species that inhabit National Forests. Concurrent with the biopolitical forces that culminated with Congressional legislation were symposia/workshops that summarized the current knowledge of national and regional bird habitat relationships and management.

The forest and rangelands nongame bird symposium in Tucson, Arizona, in 1975 (Smith 1975) began a major redirection in U.S. Forest Service wildlife research. The changing emphasis was largely based on the recent congressional legislation and on growing public opinion. The shift in emphasis from game species to nongame birds started a trend that has continued to the present. Topics covered in the symposium included: (1) an evaluation of economic values and the increasing trend of Americans watching birds for nonconsumptive recreation, (2) silvicultural options and habitat values for birds in deciduous forests, (3) birds and rangelands, (4) silvicultural options for birds in coniferous forest habitats, (5) nongame bird management on National Forests, and (6) information needs of the Forest Service for its management of nongame birds on forest and range lands. The symposium largely represented a summary and analysis of information from researchers outside the Forest Service, and pointed out large gaps in the information needed to manage birds scientifically on

National Forests. The 1975 symposium was followed by four regional workshops that examined and reviewed avian habitat relationships and information needs more precisely; all focused on management of forests for nongame birds.

The first regional workshop was held 7–9 February 1977 in Portland, Oregon, and focused on coniferous forests of the western U.S. (DeGraaf 1978a), the second was held 24–26 January 1978 in Atlanta, Georgia, on southern forests (DeGraaf 1978b), the third workshop 23–25 January 1979 in Minneapolis, Minnesota, on north central and northeastern forests (Degraaf and Evans 1979), and the fourth 11–14 February 1979 in Salt Lake City, Utah, on western forests and grasslands (DeGraaf and Tilghman 1980).

The symposium and workshops added impetus to efforts that were underway within many of the research stations and served as a springboard from which the Forest Service could launch major internal research efforts to solve its information needs. Ornithological research expanded in nearly all of the Forest Service's research stations.

Southern Forest Experiment Station (SOFES).—At the SOFES's lab in Nacogdoches, Texas, Lowell Halls and John Stransky described a variety of plant species that produced fruits valuable to nongame bird species, and plant species important to song birds following timber harvesting (Halls 1973, Stransky et al. 1976). James Dickson and Charles Segelquist studied bird populations in pine and pine-hardwood forests in eastern Texas (Dickson and Segelquist 1979). Richard Conner began studies on woodpecker foraging and habitat use (Conner and Kroll 1979). Conner (1979) asked questions about the use of minimum standards in forest wildlife management as they relate to harvest rotation ages for trees and effects on woodpecker nesting habitat. Dickson, Conner, and others co-edited a book on the role of insectivorous birds in forest ecosystems (Dickson et al. 1979). The insectivorous bird book reviewed much of what was currently known about interactions between forest insects and birds including sampling bird and insect prey populations, avian foraging strategies, and avian ecology.

Southeastern Forest Experiment Station (SEFES).—Robert Hooper et al. (1973) examined the relationships of bird density and diversity to vegetation in forest recreation areas. Hooper et al. (1975b) studied songbird nesting in a relatively urban environment in Virginia. Hooper et al. (1975a) and Richard Harlow et al. (1975) studied Common Raven (*Corvus corax*) nesting density and habitat, and winter and nesting season foods in the mountains of southwestern Virginia.

Studies on woodpecker ecology and behavior began in the SEFES in the early 1970s. Richard Conner studied the nesting and foraging habitats, and cavity orientation of Pileated (*Dryocopus pileatus*), Hairy (*Picoides villosus*), Downy (*P. pubescens*), and Red-headed (*Melanerpes erythrocephalus*) woodpeckers and Northern Flickers (*Colaptes auratus*) in southwestern Virginia (Conner 1975, Conner and Crawford 1974, Conner et al. 1975).

North Central Forest Experiment Station (NCFES).—NCFES and Rocky Mountain Forest and Range Experiment Station personnel compiled information on cavity nesting birds in North American forests (Scott et al. 1977). Hardin and Evans (1977) reviewed cavity nesting bird habitat in oak-hickory forest, and Evans (1978) examined forest management opportunities for songbirds.

Northeastern Forest Experiment Station (NEFES).—Research on nongame birds in the NEFES included studies on songbird response to clear-cutting of spruce-fir forests (Titterington and Crawford 1979, Crawford and Titterington 1979), and birds nesting on strip-mined high walls in south West Virginia (Crawford et al. 1978). Thomas et al. (1977) examined the habitat requirements of birds in suburban areas. In the early 1970s John Gill and others evaluated forest habitat management for nongame birds in central Appalachia (Gill et al. 1974).

Rocky Mountain Forest and Range Experiment Station (RMFES).—Research on birds in the RMFES was just beginning in the 1970s. Scott and Patton (1975) developed a list of the cavity nesting birds of Arizona and New Mexico forests. Szaro and Balda (1979) studied the effects of ponderosa pine (*Pinus ponderosa*) harvesting on nongame bird populations.

Intermountain Forest and Range Experiment Station (IMFES).—Early research in the IMFES did not concern birds directly but was quite relevant. Lyon evaluated the attrition rate of lodgepole pine (*Pinus contorta*) snags, a subject important for management of cavity nesting birds (Lyon 1977).

Pacific Southwest Forest and Range Experiment Station (PSWFES).—During the 1970s research on birds in the PSWFES began to focus on birds in California and Hawaii. C. John Ralph studied disorientation of young coastal passerine migrants (Ralph 1978) and birds on Pacific islands (Ralph and Sakai 1979). Jared Verner reviewed the status of the recovery effort for California Condors (Verner 1978). Deborah Finch participated in research on the effects of pesticides on forest birds of northeastern Oregon (Richmond et al. 1979).

Pacific Northwest Forest and Range Experiment Station (PNWFES).— Woodpeckers, owls, and other cavity nesting birds were the primary interests of PNWFES avian research during the 1970s. Jack Ward Thomas edited and wrote parts of a major review volume on wildlife habitat in the managed forests of the Blue Mountains of Oregon (Thomas 1979). Evelyn Bull studied Flammulated Owls (*Otus flammeolus*), examined habitat requirements of Pileated Woodpeckers, and studied fungal decay in trees used by primary cavity nesters (Bull and Meslow 1977, Bull 1978, Miller et al. 1979).

ORNITHOLOGY IN THE U.S. FOREST SERVICE 1980 TO PRESENT: FULL BLOOM

The number of studies and the number of species studied by the Forest Service increased nearly geometrically in the 1980s and early 1990s. I will focus on some of the research areas that have had major impacts on both science and management.

Diversification of the Forest Service research team continued in the 1980s. The percentage of scientists with doctoral degrees increased, and some who lacked doctorates returned to universities to obtain them. Although some women ornithologists had been hired during the 1970s by Forest Service research, the number increased during the 1980s and 1990s.

The Audubon Wildlife Report for 1986 specifically addressed the U.S. Forest Service, its management of National Forests, adequacy of funding for both management and research, and organizational structure (Di Silvestro 1986). In general, funding to support needed research on birds and other wildlife species was considered inadequate (Barton and Fosburgh 1986). The 1980 Resource Planning Act projections indicate that funding for the Forest Service research program in general should be $314 million, but the budget for the entire Forest Service research program was only $121 million in 1985 with the majority of these funds (51.3%) going toward timber-related research (management, harvesting, inventory, genetics, use, etc). The budget for all wildlife and fisheries research during 1985 was $5.5 million. Wildlife research funding in the Forest Service falls under the Forest Environment Research category. Fiscal year (FY) 1980 funding in this line item was $7.5 million and had increased to $15.4 million by FY 1990. This apparent 51% increase over the decade translates into only a 24% increase when corrected for inflation. However, only a portion of these dollars is actually spent on bird research. The percentage of wildlife funds going toward bird research has undoubtedly increased over the past decade, probably increasing from less than 30% to more than 60% (rough estimates). There was a major shift in funding to increase research on the Spotted Owl (*Strix occidentalis*) toward the end of the 1980s but research on other species of birds generally decreased as a result of this redirection of funds.

Management of National Forests was perceived by the conservation community as being too timber-oriented at the expense of wildlife and other forest resources. The total budget for the National Forest System in FY 1985 was $1,425.9 million, but only $36.7 million was appropriated for wildlife and fish habitat management (Barton and Fosburgh 1986). The Audubon report presents a detailed examination of the conflict between timber economics and the Spotted Owl in the Pacific Northwest and good arguments concerning what happens when only minimum habitat is provided for an old-growth sensitive species (Forsman and Meslow 1986).

Significant publications relevant to ornithology.—During the 1980s the U.S. Forest Service either published or had significant involvement with several books and symposia that reported studies on birds. C. John Ralph (PSWFES) and Michael Scott (U.S. Fish and Wildlife Service) edited a highly acclaimed proceedings from a symposium held in Asilomar, California during October 1980 on estimating numbers of terrestrial birds (Ralph and Scott 1981). The volume included more than 100 papers that examined estimating relative abundance and birds per unit area, comparisons of census methods, bird species variability, environmental influences, observer variability, sampling design, and data analyses.

The U.S. Forest Service cosponsored and published a workshop proceedings edited by David Capen (University of Vermont) that was held April 1980 at the University of Vermont and addressed the use of multivariate statistics in wildlife studies (Capen 1981). The volume included a special section on techniques for sampling avian habitat from a statistical perspective, choosing which habitat variables to measure, and philosophical and theoretical aspects of habitat measurement and habitat use by birds. The proceedings of the workshop also included many applications of multivariate statistical techniques to avian habitat data.

The importance of snags to cavity nesting birds and other wildlife remained important to the U.S. Forest Service in the 1980s. In June 1983 at Flagstaff, Arizona the U.S. Forest Service cosponsored a symposium on snag habitat management coordinated by Jerry Davis, Gregory Goodwin, and Richard Ockenfels (Davis et al. 1983). The proceedings included more than 40 papers that examined the importance and characteristics of snags for birds and other cavity nesters, snag management, habitat and species requirements for snags, and monitoring and modeling snags in ecosystems. The utility of nest boxes and other artificial cavities was also discussed.

In 1986 Richard DeGraaf and Deborah Rudis authored a synthesis of information on the habitat, natural history, and distribution of New England amphibians, reptiles, mammals, and birds (DeGraaf and Rudis 1986). The volume described the range, relative abundance, nesting, territory size, foraging characteristics, and special habitat needs for 163 species of birds.

The Forest Service continued to demonstrate an interest in modeling avian habitat. Jared Verner, Michael Morrison (University of California, Berkeley), and C. John Ralph edited a book on modeling habitat relationships of terrestrial vertebrates that was based on a symposium held at Fallen Leaf Lake, California, in October 1984 (Verner et al. 1986). The book included 75 papers most of which dealt with avian habitat and ecology. Topics examined in the book included development, testing, and application of wildlife-habitat models; biometric approaches to modeling; and habitat patchiness, fragmentation, and vegetational succession. Also during the 1980s Ralph received the Wilson Ornithological Society's Edwards Prize for a study of avian age ratios and autumn routes of migrating passerines (Ralph 1981).

In 1985 the U.S. Congress passed legislation that created or added additional wilderness areas to the eastern United States. The concern and support of the Forest Service for scientifically sound management of wilderness areas led to its support of a symposium held in Nacogdoches, Texas, in May 1985 on wilderness and natural areas in the eastern United States. The resulting book included more than 65 papers that addressed wilderness management problems, including papers on raptors, Wild Turkeys, and Red-cockaded Woodpeckers (Kulhavy and Conner 1986).

Wildlife population viability: a continuing issue.—During the 1980s the U.S. Forest Service continued its conceptual and applied consideration of the requirement to maintain viable populations for all wildlife species. John Lehmkuhl suggested methods for determining viable population sizes and distributions for land management planning (Lehmkuhl 1984). Fred Samson and others explored the problems and solutions of determining and managing minimum population sizes (Samson et al. 1985). Jared Verner suggested that the concept of guilds be applied to the management of bird populations (Verner 1984). Hal Salwasser and others described wildlife population viability as a concept of risk of extinction (Salwasser et al. 1984). Conner exhorted scientists and managers to consider managing for ecologically functional populations of all bird species and other wildlife rather than for minimally viable populations bordering on extinction (Conner 1988).

Threatened and endangered species in the 1980s and beyond.—A growing percentage of Forest Service Research and NFS's budgets were spent on endangered birds during the 1980s and the early 1990s. During the early 1980s the Red-cockaded Woodpecker received the most research attention, but was rapidly surpassed by the Spotted Owl. Research in the Southeastern Forest Experiment Station by Hooper, Lennartz, and Harlow was fundamental in understanding aspects of the foraging requirements and home range needs of this woodpecker (Hooper and Lennartz 1981, Hooper et al. 1982).

Research conducted by Richard Conner and D. Craig Rudolph in the Southern Forest Experiment Station in Nacogdoches, Texas, and information compiled by Ralph Costa and Ronald Escano in the Atlanta Regional Office were crucial to revealing that existing management on National Forests was not effective for small Red-cockaded Woodpecker populations (Conner and Rudolph 1989, Costa and Escano 1989). Data collected by Conner and Rudolph (1989) had indicated that Red-cockaded Woodpecker populations on Texas National Forests were in a severe decline as a result of inadequate hardwood midstory control, woodpecker group isolation, and forest fragmentation. Their data, documents obtained with a pretrial discovery order, and information on the population decline presented in trial testimony by Conner, were used by Sierra Club Legal Defense Fund attorney Douglas Honnold and Texas Committee for Natural Resources attorney Edward Fritz in a lawsuit that came to trial in March 1988 alleging that the U.S. Forest Service had violated Section 7 (failure to make timely consultation with the U.S. Fish and Wildlife Service) and Section 9 (harm or take of an endangered species) of the Endangered Species Act (Bigony 1991). Federal Judge Robert Parker found the U.S. Forest Service in violation of both sections 7 and 9 of the Endangered Species Act. The U.S. Forest Service appealed the decision in December 1988, but both the section 7 and 9 violations were sustained by the Fifth U.S. Court of Appeals. The trial, decision, and affirmation by the appellate court established legal precedent nationally—"take" under Section 9 of the Endangered Species Act now legally includes population declines that result from failure to manage habitat correctly for an endangered species (Bigony 1991).

During the late 1980s and the early 1990s the Forest Service increased its study of the Spotted Owl. A conservation strategy synthesized by an interagency committee chaired by Jack Ward Thomas (Thomas et al. 1990) was critical to the understanding of the problems faced by the owl and its management needs. The "Thomas Report" survived all efforts to discredit it by timber, environmental, and other political interest groups. Forest Service support for research completed by Eric Forsman, Charles Meslow, and Howard Wight (all U.S. Fish and Wildlife Service) was a major scientific contribution to an understanding of the biology and habitat needs of the owl (Forsman et al. 1984). Rocky Gutierrez (Humbolt State University) and Andrew Carey edited a volume on the ecology and management of the Spotted Owl in the Pacific Northwest (Gutierrez and Carey 1985).

U.S. Forest Service financial support for research on the Puerto Rican Parrot and the aviary for captive breeding at the Luquillo Experimental Forest continued during the 1980s. Wayne Arendt studied the impact of ectoparasites on growth and development of nestling Pearly-eyed Thrashers (*Margarops fuscatus*) and adult reproduction (Arendt 1985a, 1985b).

Forest Service research has also included other endangered species. John Probst studied Kirtland's Warbler breeding biology, habitat, and management (Hayes et al. 1986, Probst 1986, Probst and Hayes 1987). Coleman Crocker-Bedford authored a study on Northern Goshawk (*Accipiter gentilis*) reproduction and forest management which indicated that cutting patterns and the resulting habitat fragmentation were negatively impacting a Northern Goshawk population (Crocker-Bedford 1990).

Neotropical migratory bird program.—The 1990s saw the dawn of a major concern within the U.S. Forest Service for declining populations of neotropical migratory birds. A statement of concern, summary of population trends, and possible reasons for declines were synthesized by Deborah Finch (Finch 1991).

Forest Service personnel holding offices in ornithological societies.—During the late 1980s and early 1990s Forest Service personnel served as officers in several ornithological societies. Jared Verner was elected President-elect of the Cooper Ornithological Society in 1987 and served as President from 1989 to 1991. Martin Raphael served as Assistant Secretary for the Cooper Ornithological Society from 1987 through 1992. Richard Conner was elected Second Vice President of the Wilson Ornithological Society for 1989 and 1990, First Vice President for 1991 and 1992, and President in 1993 and 1994.

The future of ornithology in the U.S. Forest Service.—Forest Service research on threatened and endangered birds will probably continue at current levels or increase in the future as an increasing number of species decline in population. Research on species like the Spotted Owl, Red-cockaded Woodpecker, and Marbled Murrelet (*Brachyramphus marmoratus*) that require older-growth forest habitat will undoubtedly increase. Emphasis on neotropical migrants, especially those requiring large unfragmented tracts of forest, will continue to be a concern of the Forest Service, as will interest and concern in tropical forestry and species like the Puerto Rican Parrot. The need for research on many cavity-nesting birds will also probably continue because of the conflict between provision of old-growth trees for wildlife and timber product needs.

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11

The Emergence of Canadian Ornithology—An Historical Overview to 1950

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ABSTRACT.—Originally influenced by French and British colonial and scientific concerns, ornithology in Canada, after the middle of the 19th century, developed in a larger North American context. In contrast to the U.S., however, there was little government funding, and no large pools of private capital to underwrite scientific research. In fact, until the 1950s, funding for Canadian ornithologists came from foreign sources, such as the Royal Society of London, the U.S. National Research Council, and a few generous American naturalists. Because of this, much of Canadian ornithology developed outside the institutional framework of universities and research institutes usually considered necessary for scientific research.

In investigations of the life history, migration, and behavior of economically important bird species, Canadians contributed to theoretical and methodological advances in ornithology. Mousley was a pioneer of territoriality theory and an early experimentalist in life history studies. Ivor was one of the first to investigate anting and to conduct comparative studies on wild and semi-tame birds. Munro, Lewis, and Hochbaum studied the ecology of waterfowl. The well-known experimental research of Rowan on the physiological basis of bird migration initiated a large volume of new research in the United States and Europe and brought him world-wide recognition.

By the mid-20th century a tradition of ornithological research was established in Canada. During the following decades this led to the expansion of the Canadian Wildlife Service, and the ornithology sections of the various natural history museums. Ornithology also became part of academic training in biology, ecology, and wildlife management in Canadian universities.

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The emergence and development of Canadian ornithology can be studied within the framework of the diffusion of Western science into areas of the world that were not part of the European scientific tradition. In the initial phase of this diffusion, "new" areas provided source material for European scientists. This was followed by a period of colonial science that was dependent on European educational and scientific institutions and affiliations. Independent scientific traditions in the "colonies," with their own educational and scientific institutions, developed much later (Basalla 1967).

From the mid-16th to the mid-19th century, European navigators, explorers, and colonizers observed, collected and described natural history specimens in the large geographic area now called Canada. Most of the observers before the 18th century were untrained in science. Their scientific activities occurred as by-products of the geographic exploration/colonizing activities of western European nations.

In Nouvelle France, the major scientific impetus for natural history collections came from the Académie Royale des Sciences in Paris. Descriptions and specimens of plants and animals were sent to France for study (Levere and Jarrell 1974).

From the beginning of the 17th century, English navigators and explorers provided natural history information from northern North America. Initially, they included some descriptions of the flora and fauna in their writings. Later, Hudson's Bay Company employees sent sporadic information from the Hudson Bay region then called Rupert's Land. The Royal Society of London (established 1662) subsequently enlisted the support of Hudson's Bay employees—intelligent, practical men, "upon whose observation scientists could rely" (Stearns 1945, Houston 1983, Ainley 1985). Little did they know that much of the observation and collection was done by the aboriginal peoples of the Hudson Bay watershed. Many of these were women who formed relationships with the Hudson's Bay Company employees (Van Kirk 1980). Although their names as collectors of birds were not recorded until the late 19th century, their knowledge of native flora and fauna, and their familiarity with the life history of breeding birds, made them the first assistants in Canadian ornithology (Ainley 1990).

Ornithology in Canada, for three centuries, remained a cooperative venture. Its participants included the aboriginals whose thorough knowledge of the natural world assisted the part-time observers and collectors of specimens (members of the European scientific culture), and the "absentee landlords of science" (Fleming 1962), mostly Europeans who, without actual experience with Canadian natural history, used the information received in their popular and scientific works (Ainley 1985).

During this period, increased interest in ornithology as a separate field of study led to the development of small groups of specialists in several European nations (Farber 1982). Notes and specimens of Canadian birds were permanently incorporated by these experts into the ornithological literature and museum collections. Thus the records of the birds of Acadia, Nouvelle France, Newfoundland and Labrador, and Rupert's Land contributed to the developing science of ornithology through the publications of George Edwards, Thomas Pennant, John Latham, J. R. Forster, and later, Nicholas Vigors, William Swainson, and Sir John Richardson in England. On the European continent, scientists using this information included Linneaus in Sweden, J. F. Gmelin in Germany, and J. M. Brisson, Georges-Louis Leclerc de Buffon, and Georges Cuvier in France (Stresemann 1975, Ainley 1985).

The area included in these sporadic observations was so huge that it could not be thoroughly surveyed from either a geographic or a natural history point of view until the early 19th century. Britain, with its widely scattered colonies, numerous scientifically trained military and naval officers, and penniless young aristocrats in search of adventure, was in a good position to organize and direct large-scale exploring and surveying ventures. Ornithology in early 19th century Canada was a by-product of general natural history investigations which were only a side-issue of the large-scale explorations and surveys. According to John Richardson, surgeon-naturalist to the first two Franklin expeditions (1819–22, 1825–27), natural history was "only a subordinate object" of the expeditions (Richardson 1831). The same could be said of other Arctic expeditions and geological and boundary surveys conducted in Canada from the 1850s to the 1880s. The only exceptions were the Smithsonian Institution's natural history survey to Arctic America in the late 1850s, and the Geological and Natural History Survey of Canada after 1877. These large, organized exploring parties contributed considerably to our knowledge of Canadian fauna and flora (Ainley, 1985).

NEW DEVELOPMENTS

During the first half of the 19th century, the study of birds in Canada was not confined to the various exploring parties. Settled naturalists could observe their region much more thoroughly than could the explorers and surveyors whose observations were limited to a few seasons. The number of local and regional observers was small. Only "a handful of educated people with a taste for natural history remained in Lower Canada [now Quebec], most of them . . . physicians and clerics" who maintained the natural history tradition of Nouvelle France (Levere and Jarrell 1974).

In Upper Canada (now Ontario) there were few educated settlers with sufficient wealth and leisure to pursue such studies. In contrast to the utilitarian aspects of science, such as agriculture and mining, strongly supported by the new Scottish and United Empire Loyalist settlers, natural history remained underdeveloped. While certain individuals observed and studied birds, such as the painter William Pope (1811–1902) in the Long Point region of Lake Erie in the 1830s and 1840s, and the naturalist Philip Henry Gosse (1810–1888) in the Eastern Townships (Quebec), there was little support for Charles Fothergill (1782–1840) who, in the 1830s, attempted to establish a natural history society and museum in Toronto.

In the Maritimes, the Scottish-born Thomas McCulloch (1776–1843) made a bird collection which impressed the visiting John James Audubon, on his way to Labrador in 1833. Andrew Downs (1811–1892) in 1847 in Halifax, established the first zoological garden in North America. His *On the Landbirds of Nova Scotia* (1865, 1866) incorporated his observations over a 40-year period. Archibald Hall (1812–1868), a Montreal-born physician, educator, and editor studied the birds of the Montreal region. *On the Mammals and Birds of the District of Montreal* prepared for the Montreal Natural History Society in 1839 received the society's silver medal. John Cassin requested the paper for use in the "preparation of a work of his," but did not publish on it for 20 years! Finally, Hall published the paper in the *Canadian Naturalist and Geologist* (1861). Elliott Coues (1878) praised it as the "most important Canadian contribution to ornithology extant."

By the time Hall's manuscript went to print, naturalist-ornithologists were collecting birds in Montreal, Quebec, Kingston, Toronto, Hamilton, Halifax and other areas. Natural history became an accepted pursuit in the larger centers, and local natural history societies provided opportunities to meet other naturalists, discuss interesting findings, and read and publish papers. Membership in these societies consisted of the educated middle class, although they were democratic enough to accept anyone with an interest in natural history—including women. Observers in the smaller communities remained isolated (Ainley 1985).

Another major development was the involvement in the mid-19th century of naturalists from the United States in the study of Canadian flora and fauna. Robert Kennicott (1835–1866), the first naturalist-ornithologist in the Arctic, was sent there by the Smithsonian Institution for the sole purpose of conducting a natural history survey in the Hudson Bay area. Kennicott was one of many naturalist-collectors working for Assistant Secretary Spencer F. Baird (1823–1887) of the Smithsonian Institution. Kennicott's visit to the Arctic (1859–62) was, however, the first time that a member of Baird's network of naturalists studied birds on British-Canadian territory. His presence in the north prompted a resurgence of interest in natural history observations by Hudson's Bay Company personnel (Deiss 1980). During the following 100 years, other U.S. ornithologists followed Kennicott into Canada. The U.S. institutions were more numerous, better organized, and definitely better funded than Canadian ones. Thus they were able to conduct surveys in Canada while many Canadian ornithologists had to be content with more local and regional activities.

Baird and the Smithsonian were to fulfill the role which the Académie Royale des Sciences and the Royal Society held in the late 17th and 18th centuries. In retrospect, it is evident that the first U.S. natural history survey in Canada constituted an important landmark. It was symptomatic of a great change affecting Canadian science in the middle of the 19th century. Until that time, scientists in Canada had looked to Britain for information, intellectual stimulation, and exchange of scientific specimens and ideas. They belonged to British scientific organizations and published papers in British journals. After the mid-19th century there was a noticeable shift of the center of Canadian science from Britain to the United States. Canadian ornithologists, as well as botanists, entomologists, mammalogists, geologists, and paleontologists began to look for institutional affiliation and scientific exchange with their U.S. peers. By the 1860s, ornithological material was sent not only to Britain, but also to U.S. museums and collections. Articles on the birds of Canada, formerly published exclusively in British journals, now began to find their way into Canadian and U.S. publications, such as *The Canadian Journal* and *The Proceedings of the Essex Institute.*

A CANADIAN ORNITHOLOGICAL COMMUNITY

The many natural history societies established in the first half of the 19th century provided forums for general and specialized naturalists. Although articles on geology, palaeontology, and meteorology outnumbered those on ornithology, notes and articles on Canadian birds appeared increasingly in the *Canadian Journal* (established in 1852 in Toronto), the *Canadian Naturalist and Geologist* (established in 1857 in Montreal), the *Transactions of the Ottawa Field Naturalist Club* (established in 1879) and the short-lived *Canadian Sportsman and Naturalist* (1881–83). Papers on Canadian ornithology also appeared in *The Zoologist, The Ibis, The Annual Report of the Smithsonian Institution, American Naturalist, Forest and Stream,* and *The Ornithologist and Oologist,* among others. Bird studies became wide-spread after 1850. James McPherson Lemoine (1825–1912), John Neilson (1821–1895), and William Couper (d. 1890) in Quebec; J. Bernard Gilpin (1816–1892) and J. Matthew Jones (1828–1888) in Halifax; Francis Bain (1842–1894) on Prince Edward Island; Leith Adams (d. 1882) and Montague Chamberlain (1844–1924) in New Brunswick; and George R. White (1856–1927), William L. Scott, and later John Macoun (1831–1920) in Ottawa were all active in local and regional bird study and collection. In London, Ontario, Henry P. Attwater (1854–1931), John A. Morden

(1859–1937), and W. E. Saunders (1861–1943) collected, and published on birds, while Ernest Thompson Seton (1860–1946) studied birds and mammals in both Ontario and what is now Manitoba during 1882–1892.

As the century progressed a number of keen observers and collectors added to our knowledge of Canadian avifauna. Montague Chamberlain began his ornithological activities around 1870, joined the New Brunswick Natural History Society in 1880, and soon contributed to the society's bird collection. His notes and papers appeared in *The Bulletin of the Nuttall Ornithological Club* and *The Auk*. His major work was *A Systematic Table of Canadian Birds* (1888).

The most important Canadian ornithologist of the period, Thomas McIlwraith (1824–1903), began his observations soon after his arrival in the Hamilton region in 1853. His *Birds of Hamilton, Canada West,* originally prepared for the Hamilton Association in 1860 was updated and expanded (1866). He later published notes and articles in the *Bulletin of the Nuttall Ornithological Club*, the *Canadian Sportsman and Naturalist,* and *The Auk*. McIlwraith and Chamberlain became well known to their American colleagues, and in 1883 were among the Founders of the American Ornithologists' Union (AOU).

Between 1860–90 there was a considerable increase in the number of ornithologists throughout Canada. The numerical growth of these enthusiastic observers was important. It was only with repeated and systematic observations in a great variety of habitats across the country that a relatively accurate picture of the natural history of birds of Canada could emerge. The need for this type of study was well understood in the United States, where the expeditions of the Smithsonian Institution and various other museums explored the natural history of birds in many different geographic regions. The topics for ornithological investigations were determined by Baird in the 1850s, and taken over by the AOU after 1883.

In the last quarter of the 19th century, much of Canada was still sparsely settled. Keen ornithologists exchanged specimens or bought them from professional collectors. Local taxidermy shops and food markets provided both specimens and information on migration and geographic distribution. In Quebec City Charles Eusebe Dionne (1845–1925) discovered many birds of the region at the various food markets. Ernest Wintle (1852–1917) collected information on birds by frequenting the Bonsecours Market in Old Montreal. Study skins were important at a time when binoculars and field guides, taken for granted by 20th century ornithologists, were practically nonexistent. There were no large natural history museums—only the private or natural history societies' collections were available for those intending to learn about the bird life of areas other than their own.

While formal education in ornithology was non-existent in late 19th century Canada, some natural history courses were offered at colleges and universities. Natural history professors, including the Rev. William Hincks of University College, Toronto, and J. W. Dawson, McGill College, Montreal, encouraged the observation and collection of birds.

During this period, jobs were scarce for naturalist-ornithologists. Charles E. Dionne was appointed curator at the Laval University Museum in 1882 and John Fannin at the British Columbia Provincial Museum in 1887, while the governments of Ontario and Manitoba and the Northwest Territories employed Charles Nash and George Atkinson, respectively, as consulting naturalists.

In contrast to the U.S., there was no clear cut government policy in Britain to encourage bird study at home or in the Dominions. The Canadian government's scientific orientation was exclusively utilitarian, and ornithology did not become a part of the government scientific establishment until the second decade of the 20th century. Even the Experimental Farms and the federal Department of Agriculture did not employ an ornithologist. When, at last in 1887, a position opened up within the federal government for a naturalist-ornithologist, it was not with the Department of Agriculture, but with the Geological and Natural History Survey of Canada (Ainley 1985).

After an initial period of natural history work (1842–77) carried out on a part-time basis by Survey personnel, the Survey's mandate changed to include natural history observations and collection. Increased personnel led to the hiring of John Macoun as botanist, but no one else to conduct zoological studies. Montague Chamberlain's attempts to have the Survey create a position of ornithologist met with failure (see correspondence between Chamberlain and William Brewster, Brewster papers, Museum of Comparative Zoology Archives, Harvard University). Macoun, not an expert in zoology, but confident that he could do the work needed, was allowed to carry out ornithological and mammalogical surveys in addition to his botanical work (Waiser 1989).

While ornithological work remained sporadic in the Survey, individual ornithologists carried out important studies in southwestern Ontario. Percy Algernon Taverner (1875–1947), J. H. Fleming (1872–1940), W. E. Saunders, and A. B. Klugh studied distribution and migration in the Great Lakes region around the turn of the century and in 1905 established the Great Lakes Ornithological Club (Cranmer-Byng 1984). Fleming and Saunders remained independent ornithologists, Klugh became a professor of biology at Queen's University and Taverner, in 1911, was hired as "Naturalist, Preparatory and Assistant Curator, Natural History" for the Victoria Memorial Museum, later the National Museum of Canada (see chapter 12 this volume).

While Taverner and the National Museum were to map the birds of Canada, and coordinate widely dispersed ornithological work, the smaller, regional museums also carried out field work to provide specimens for exhibitions and study collections. Preeminent were the Provincial Museum of Saskatchewan (established 1906), and the Royal Ontario Museum of Zoology (ROMZ) founded in 1913 (see chapter 13 this volume). By the early 1930s, they were considered the best Canadian provincial museums.

These two museums contributed much to Canadian ornithology with their exhibits and study collections. They popularized ornithology in their respective provinces and helped establish important nature sanctuaries. While only a few scientific publications resulted from the Saskatchewan Natural History Museum's activities, the ROMZ staff published taxonomic and faunistic works on local and regional ornithology. An unusual study of the Passenger Pigeon (*Ectopistes migratorius*), resulted in a major monograph by Margaret H. Mitchell on the life history of an extinct species (1935).

LIFE HISTORY STUDIES

Although distributional studies in Canada lagged behind those of the U.S., there was considerable interest in some aspects of life history work. The economic aspects of life history were studied by Taverner, as well as by J. A. Munro and Harrison F. Lewis, while isolated naturalists, many living close to nature or having the opportunity to spend long periods outdoors, engaged in extended field observations. Studies by Allan Brooks (1869–1946), Charles de Blois Green, William J. Brown, F. Napier Smith, Lewis McIver Terrill (1878–1968), and others dealt with various aspects of breeding and feeding behavior of birds. They published papers and notes on their observations in *The Auk*, *Ottawa Naturalist*, *Wilson Bulletin*, *Murrelet*, and other journals, or in government publications, and provided data for A. C. Bent's "Life History" volumes.

Long-term studies of individual bird species were done by Terrill on the Fox Sparrow (*Passerella iliaca*) (1968), Doris Huestis Speirs (1894–1989) on the Evening Grosbeak (*Coccothraustes vespertinus*) (1968) and, with J. M. Speirs (b. 1909), on the Lincoln Sparrow (*Melospiza lincolnii*) (1968).

Among the many Canadian ornithologists pursuing life history and behavior studies during the 1900–1950 period were some whose contributions put them in the forefront of ornithological research. Outstanding were Harrison F. Lewis (1893–1974), Louise de Kiriline Lawrence (1894–1992, see fig.1), William Henry Mousley (1865–1949, see fig. 2), and Hance Roy Ivor (1880–1979). In the 1920s Lewis, the first Canadian scientist to obtain a Ph.D. in ornithology at Cornell University, studied the natural history of the Double-crested Cormorant (*Phalacrocorax auritus*) (1929). He conducted field investigations in the Gulf of St. Lawrence for several seasons and kept birds in captivity at Cornell "for observation and experiment." His official duties as Migratory Bird Officer and as editor of the *Canadian Field-Naturalist* prevented further long-term research.

Louise de Kiriline Lawrence began observing and banding birds in northern Ontario during World War II. She studied woodpeckers, jays, vireos, and warblers. Her major work was on the comparative life history studies of four woodpecker species (1967) and papers in *The Auk*, *Canadian Field-Naturalist*, and *Wilson Bulletin* quickly brought her to the attention of the larger ornithological community. Ernst Mayr regarded her as one of the best life-history researchers in North America (Mayr 1975, Ainley 1985).

William Henry Mousley was perhaps the best all-round naturalist-ornithologist in Canada. Born in England, and trained as a civil engineer, he settled in 1910 in the Eastern Townships region of Quebec. He provided the first long-term study of the region, and his papers in *The Auk* met with critical acclaim in Canada and the U.S. Mousley studied the nesting behavior of shorebirds and warblers. His first experimental work was conducted on 14 species of birds from 1911–1916 (1917). During the 1910–1918 period Mousley collected data for what became his best theoretical papers (1919, 1921). These established him as one of the forerunners of the "territory theory" (Nice 1933, Ainley 1981).

In contrast to Mousley, whose experimental work was carried out exclusively in the field, H. Roy Ivor studied the comparative behavior of semi-captive and wild birds in and around his aviary in Ontario. The efforts of an unaffiliated, self-trained ornithologist, such as the eccentric Ivor, who had the originality to experiment with semi-tame birds, were met with skepticism by some scientists and administrators funding research.

In the mid-1930s Ivor began to study the comparative behavior of hand-reared and wild birds of several species. He foresaw the importance of breeding wild birds in captivity, not only for research, but also for the preservation of endangered species. Ivor studied anting in 31 species of wild and captive birds (1943). While he is best remembered for his pioneering research on anting, he published other important papers in *The Auk*, *Wilson Bulletin*, *Nature Magazine*, and *National Geographic Magazine*.

Louise de Kiriline Lawrence, Doris H. Speirs, W. H. Mousley and H. Roy Ivor provide outstanding examples of the contributions non-professional scientists have made to ornithology. Their close observations of birds in a limited geographic area and their painstaking research over long periods of time, allowed them to pursue studies that most academic or museum scientists had no time for.

Fig 1. Louise de Kiriline Lawrence in her outdoor laboratory, Pimisi Bay, Ontario, ca. 1941. Courtesy of Georgina Rawn.

BIRD MIGRATION STUDIES

All active Canadian ornithologists during the late 19th and first half of the 20th century contributed to migration study. Additionally, early settlers on the Canadian prairies, such as the Wemyss sisters, George Lang, and Elsie Cassels sent migration data to the AOU, the U.S. Biological Survey, and later to the National Museum of Canada.

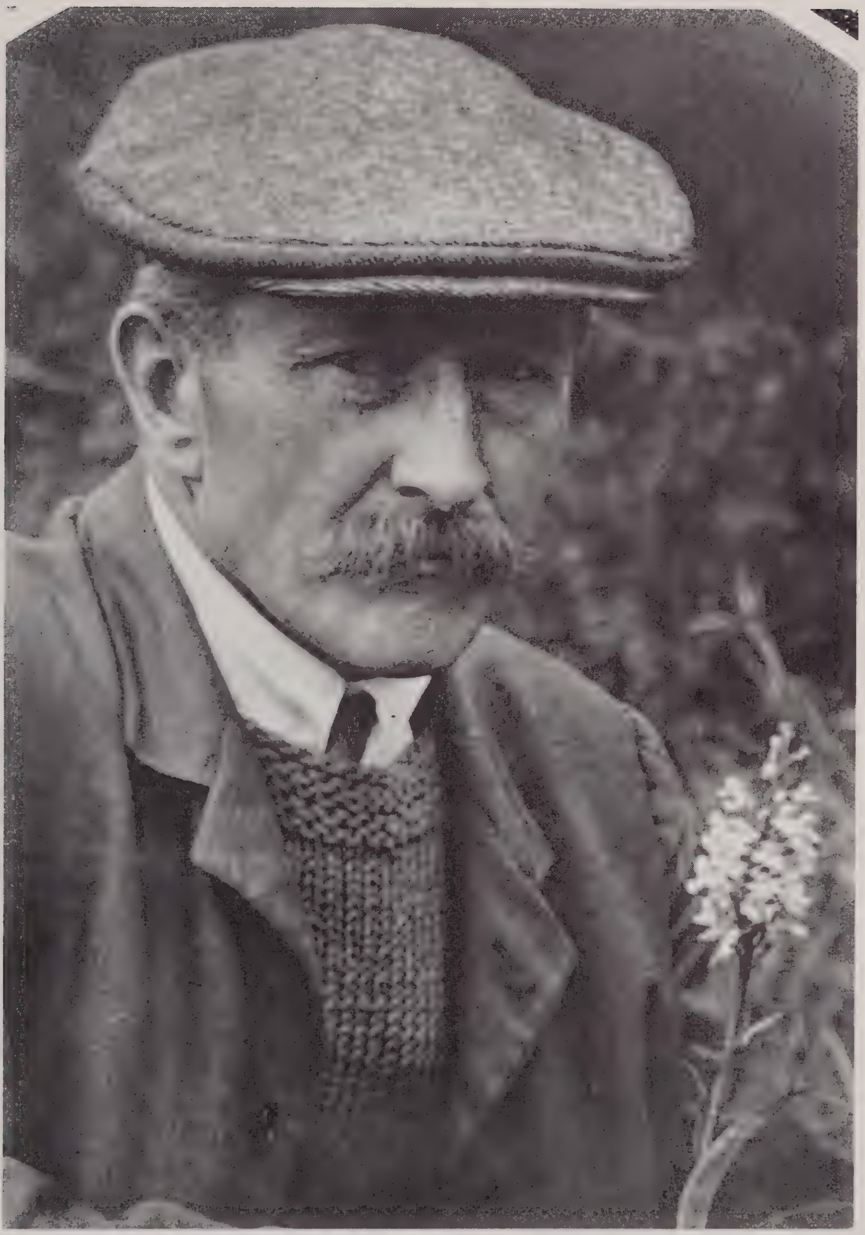

Fig. 2. W. H. Mousley in the Eastern Townships, Quebec, ca. 1915. Courtesy of Gwen Mousley.

Chamberlain, McIlwraith, Saunders, Wintle, and others discussed migration in their books, and published on their observations in the *Canadian Record of Science*, *Bulletin of the Nuttall Ornithological Club*, and *The Auk*. In the early 20th century, publications on migration proliferated. J. H. Fleming, Allan Brooks, W. H. Mousley, H. F. Lewis, Lewis McIver Terrill, Owen Merriman (1895–1934), and P. A. Taverner constituted the core of a much larger Canadian group publishing papers on bird migration (Ainley 1985).

The most important Canadian ornithologist of the first half of the 20th century was William Rowan (1891–1957, fig. 3), best remembered for his innovative experimental work on bird migration. Born in Switzerland, educated in France and England, Rowan worked on a ranch while observing and photographing wildlife on the Canadian prairies from 1908 to 1911. He studied zoology at University College London, 1911–1917, and returned to Canada in 1919 as lecturer of zoology at the University of Manitoba. The following year he was offered the opportunity to build a Department of Zoology at the University of Alberta.

Rowan began extensive field studies of Alberta birds in the Edmonton district. His early interest in migration, originally acquired in England, was reawakened by huge flocks of migrating shorebirds and waterfowl at Beaverhills Lake. He supplied migration data to the U.S. Biological Survey, and by 1922 Rowan began to work on a series of landmark papers on bird migration.

After several years of collecting field data, Rowan sought to prove experimentally that migration, at least in some species, receives an external stimulus, "an environmental timing mechanism" of periodic nature (Rowan 1946). Rowan isolated daylength, which changes at the same rate every year, as the one unvarying environmental factor. In 1924 he set out to prove his hypothesis experimentally.

In his original small-scale research in 1924–25, Rowan induced spring migratory readiness during the fall in the Dark-eyed Junco (*Junco hyemalis*). Encouraged both by the success of his first publication on the subject in the prestigious British journal *Nature*, and the intellectual support of his own colleagues and other scientists including Julian Huxley, Rowan applied for grants to carry out large-scale experimental work on bird migration. A series of grants from the Royal Society of London and the U.S. National Research Council enabled him to conduct further research on juncos (1926–28) and on the American Crow (*Corvus brachyrhynchos*) (1929–31). Rowan published a number of papers on his research in *Nature*, the *Proceedings of the Boston Society of Natural History*, *Proceedings of the National Academy of Sciences*, and other journals, as well as a book, *The Riddle of Migration* (1931). His junco experiments formed the basis of his D.Sc. thesis at University College London.

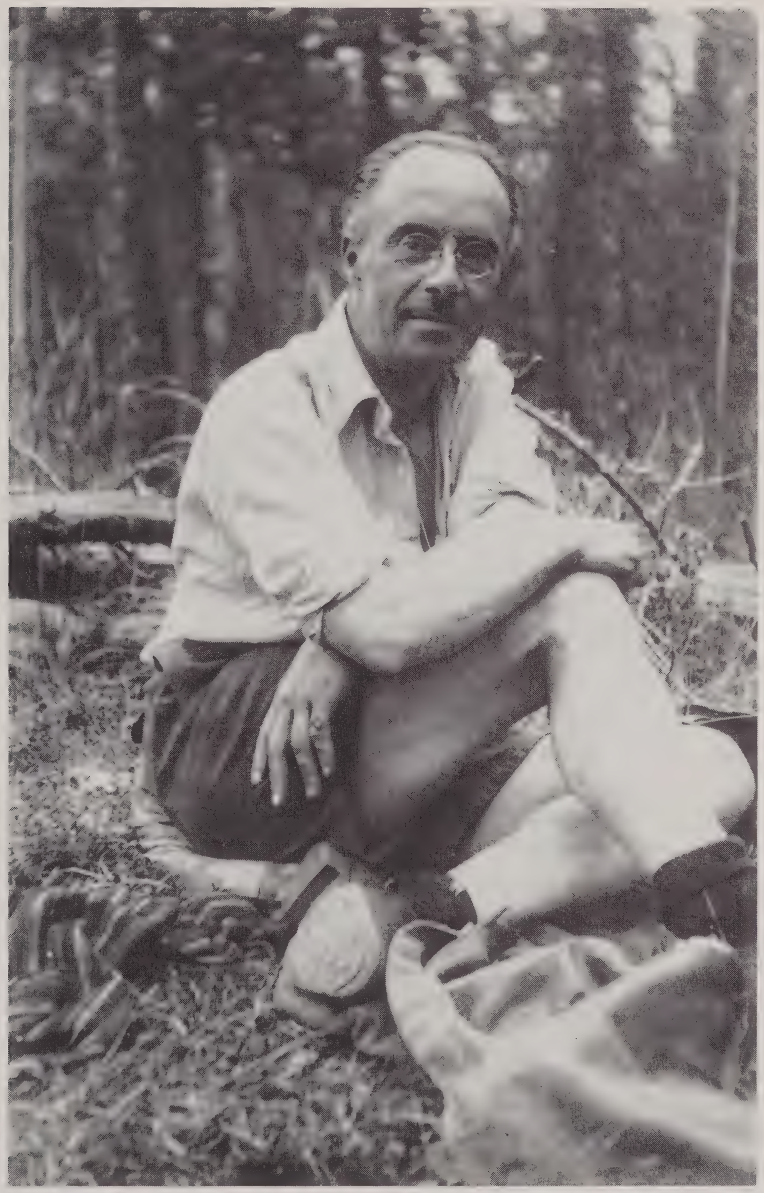

Fig. 3. William Rowan in northern Alberta, 1931. Courtesy of the University of Alberta Archives.

Rowan's research on bird migration combined field work, experimental work, and traditional laboratory work (histology). His was a new approach in bird study—one that contributed to the development of modern avian biology.

Rowan's experiments created great interest in the international scientific community, because the phenomenon of migration had long fascinated scientists and because he introduced experimentation into ornithology. Ornithologists were slow to develop research programs and the formulation of testable hypotheses remained the domain of embryologists, physiologists, and geneticists well into the 20th century. In fact, despite some early experiments on birds by Bernard Altum in Germany in the 1870s, J. B. Watson and K. G. Lashley in the U.S. from 1907 to 1910, and H. W. Mousley in Canada from 1911 to 1916, until Rowan's research at the University of Alberta most ornithologists did not use manipulative procedures or conduct rigorous biological experiments.

Rowan's innovative approach in studying the physiological basis of migration stimulated much experimental work in Europe and North America. During the next two decades, investigations into the effects of daylight on the reproductive cycle of animals were extended by Rowan and others to include more than 50 species of animals of all classes of vertebrates (Ainley 1988, Ainley 1993).

INTERCONNECTIONS

By the second quarter of the 20th century, the transformation of natural history-ornithology to avian biology was well on its way. This change in orientation occurred simultaneously in Europe and North America, and Canadian ornithology was part of this larger trend. Factors responsible for changes in ornithological research included conceptual developments, the use of new techniques, and the strengthening of interconnections with other fields of biology. The increased need for economic ornithology and wildlife management, together with the discovery of birds as environmental indicators, led to the growth of applied ornithology.

Research prompted by conservation concerns was conducted simultaneously in the U.S. and Canada during the 1920–1950 period. In many cases the studies complemented each other, but originally Canada had lagged behind the U.S. For instance, in the early part of the century there were no Canadian citizens' groups or scientific associations to lobby for wildlife preservation, and the federal government took little interest in the matter. The so-called Commission of Conservation, established in 1909, attempted to apply the results of up-to-date science and technology to industry. Conservation simply meant that natural resources should be used "reasonably" for better development. There were a number of different provincial game laws, however. It was only after the ratification of the Migratory Bird Convention Act (1917) that the federal government assumed responsibility for bird protection. While its concern was mainly in the enforcement of bird protection and a post was established for a "Dominion Ornithologist" to coordinate the work, there were a number of migratory bird officers who also conducted mission-oriented research. Hoyes Lloyd (1888–1978) was hired in 1918 as "Dominion Ornithologist." Trained in science (although in chemistry and not biology), Lloyd was a keen ornithologist and conservationist. For the rest of his life he remained involved in various aspects of ornithology and wildlife conservation.

During the 1920s and 1930s most of the scientific activity undertaken by the Migratory Bird officers (including Robie Tufts in Nova Scotia, Harrison F. Lewis in Quebec and Ontario, and J. A. Munro in the four western provinces) concerned waterfowl. Their efforts were part of a continent-wide attempt to increase knowledge of the ecology and biology of waterfowl. In the 1930s, this led to the establishment of two private organizations (Ducks Unlimited and the Delta Waterfowl Research Station) for waterfowl research, conservation, and habitat management. The more scientific of these was the Delta Waterfowl Research Station in Manitoba, the creation of American industrialist James Ford Bell.

In 1931, Bell, an avid hunter concerned about the diminishing numbers of waterfowl, decided to try raising ducks in a hatchery at Delta, at the southern end of Lake Manitoba. By the end of the decade Rowan, together with Miles Pirnie and Aldo Leopold served on the Advisory Board of the new Delta Research Station. In 1938 H. Albert Hochbaum (1911–1988) began to manage the station while conducting research on Canvasback (*Aythya valisineria*) breeding biology (Hochbaum 1944). Later, numerous graduate students conducted research on waterfowl at Delta, profiting from the opportunity to study problems simultaneously using both captive and wild birds. Sponsored by the American Wildlife Institute, assistance was also provided by the Dominion Parks Branch, the U.S. Fish and Wildlife Service, and the Manitoba Department of Mines and Resources.

During the 1920–1950 period there was an increased emphasis on ecological studies of birds. In Canada, studies by Lewis and Munro considered such factors as habitat requirements, food, and predator-prey relationships. Game birds provided the subject for other projects. Research on them constituted the first interconnection of ornithology with population ecology.

Periodic population fluctuations among game birds, fur-bearing animals, insects, and fish have been documented since the 18th century, although the idea of fluctuating populations did not appear in the ornithological literature until long after hunters knew about them. J. H. Fleming (1906, 1907) was among the first to use old publications to document the occurrence of birds e.g., in Toronto, noting peak years of the Snowy Owl (*Nyctea scandiaca*). W. E. Saunders and E. M. S. Dale documented the fluctuations of the Pine Grosbeak (*Pinicola enucleator*) in Ontario (1933), and Fred Bradshaw and C. H. D. Clarke (Clarke 1936) studied the fluctuation of the Ruffed Grouse (*Bonasa umbellus*) in Saskatchewan and Ontario respectively.

In the early 1920s, William Rowan began his long-term studies of the periodic fluctuation of game birds and mammals. Because of his migration and other studies, this research lagged behind, but by 1931 Rowan conceived of a large-scale multidisciplinary research program to study population fluctuations. This program never materialized due to lack of funding. Nevertheless, Rowan carried out field surveys and experimental work on population cycles throughout the 1930s and 1940s and inspired many others, including Lloyd B. Keith, to continue the work (Ainley 1993). During the same period, in Ontario J. R. Dymond and his students (J. Murray Speirs, C. H. D. Clarke) at the University of Toronto produced a number of significant publications on cyclic phenomena and population ecology. Unfortunately, as so often before, lack of funding and the small number of trained researchers prevented large-scale studies in population ecology.

EPILOGUE

In the post-1950 period, trends begun in the previous decades continued and intensified. Research on migration, life history, behavior, physiology, ecology, conservation, and management of birds continued on an increasingly scientific basis; this included experimentation, numerical analyses and theoretical formulations. Canadians also developed interests in other areas of ornithology, including avian genetics and evolution. While unaffiliated researchers continued to contribute to Canadian ornithology, there were more employment opportunities in Canada for university-trained ornithologists and wildlife biologists. These were provided by the Canadian Wildlife Service, provincial departments of wildlife and conservation, museums, universities, and private consulting firms.

While the number of trained ornithologists has greatly increased since the mid-20th century, so too have the number of non-professional field ornithologists and conservationists. The cooperation of thousands of ornithologists (both professional and non-professional) led to breeding bird atlases of Ontario, Quebec, and the Maritime Provinces. Other major cooperative ventures include the study of shorebirds on their breeding and wintering grounds in North and South America and the captive breeding of endangered species, including the Peregrine Falcon (*Falco peregrinus*) and the Piping Plover (*Charadrius melodus*). In the 1990s, Environment Canada, the Long Point Bird Observatory, and regional and local bird clubs and conservation associations are more active than ever before in sponsoring individual and cooperative research projects on birds.

Canadian ornithologists have been active participants at the annual meetings of the AOU, the Wilson and Cooper ornithological societies, the Association of Field Ornithologists and the Colonial Waterbird Society; they also organized AOU meetings in Montreal (1951, 1991), Regina (1959), Toronto (1967), Winnipeg (1975), and Edmonton (1981). A Society of Canadian Ornithologists was established at the 1981 Edmonton meeting of the AOU. In 1986 it hosted the 19th International Ornithological Congress in Ottawa. New Canadian ornithological journals, including *Ontario Birds*, and *Picoides*, provide additional forums for papers on Canadian ornithology.

The growth and diversity of Canadian ornithological interests are well represented in a variety of books and journals. Canadian ornithologists' research and publications, their cooperation in international projects, and their active participation in scientific meetings and symposia ensure that they remain respected members of the North American ornithological community.

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12

Ornithology at Canada's National Museum

Henri Ouellet[1]

ABSTRACT.—This paper reviews the origins of ornithological activities and development of avian collections at the Canadian Museum of Nature, formerly known as the National Museum of Canada and the National Museum of Natural Sciences. Sir William E. Logan (1798–1875) was the museum's founder and John Macoun (1831–1920) its first naturalist and initiator of ornithological activities. It summarizes John Macoun's influence on Canadian ornithology and on ornithological work at the museum, including his attempts at obtaining the approval for the appointment of the first museum ornithologist, P. A. Taverner (1875–1947) who started as an ornithologist in 1911. Taverner's achievements as a museum curator and ornithologist, as well as those of his successors A. L. Rand, W. E. Godfrey, S. D. MacDonald, and H. Ouellet along with the role of other ornithologists associated with the museum are described. Finally, the future of ornithology at the Canadian Museum of Nature is considered.

The Canadian Museum of Nature, before acquiring its present name in 1990, had been known under many different designations during its history. The museum's origins date back to 1843, in Montreal, as a constituent of the Geological Survey of Canada, and to boxes of plants, rocks, stones, and fossils belonging to Sir William E. Logan (1798–1875), the founder and first director of the Geological Survey. After a brief transfer to Toronto in 1850, the museum and offices of the Geological Survey were moved back

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to Montreal in 1852. In 1881, 14 years after the British North America Act of 1867, which formed the Dominion of Canada by uniting under a new constitutional agreement the provinces of New Brunswick, Nova Scotia, Quebec, and Ontario, the Geological and Natural History Survey of Canada was relocated to Ottawa which had become the nation's capital. More than 125 metric tons of specimens, mostly rocks, stones, and fossils, were shipped to Ottawa and formed the basis of many of the present national collections. The collections and staff of the Geological Survey and of the Museum were housed from 1880 to 1910 in a downtown building which soon became overcrowded. After a long period of uncertainty, the construction of a new building was approved by government authorities for housing the Geological Survey and the Museum. The Victoria Memorial Building was constructed over several years and, although unfinished, was made available for the collections and staff of the Survey and Museum in 1910.

The Museum continued as a branch of the Geological Survey of Canada until an Order-in-Council from the Canadian Government made it officially the National Museum of Canada on 5 January 1927. A close relationship between the Museum Branch and the rest of the Geological Survey was maintained not only because the two organizations shared the same building, but, also because many services and supports were common to both organizations (Collins 1928). In 1950, following a governmental reorganization of many departments, it was resolved that the National Museum of Canada would be transferred to the newly established Department of Resources and Development, and the Geological Survey to the new Department of Mines and Technical Surveys. Concurrently, this latter department, with an important economic mission in the development of Canada's geological resources, was relocated to a new building in Ottawa, leaving the entire Victoria Memorial Building to the Museum. A close association of more than a century between the agencies thus was terminated administratively, but gave the Museum new opportunities to develop its collections, improve its exhibits, and increase its staff.

In 1957 the National Museum of Canada was transferred to the Department of Northern Affairs and National Resources and, as a result of this change of jurisdictions, the human history and natural history divisions were separated into two autonomous administrative entities (Russell 1961). This was the prelude to additional but unpredictable changes. Ten years later, the part of the National Museum of Canada dealing with natural history, through an Act of Parliament, became a more autonomous organization within the newly created Crown (government) corporation of the National Museums of Canada, and assumed a new name: the National Museum of Natural Sciences. More changes followed, the most important one in recent history taking place in 1990 when the existing Corporation of the National Museums of Canada was disbanded and each component museum (Museum of Natural Sciences, National Gallery, Museum of Man, and Museum of Science and Technology) acquired an independent status and a new name. The component that had been known for nearly 25 years as the National Museum of Natural Sciences thus became the Canadian Museum of Nature with its own board of trustees and autonomous administration.

Ornithological activities started and proceeded, throughout the museum's history, in the midst of changes that had serious consequences because the changes were far more important than just changes in names. Administrative and managerial reorganizations followed high-level structural modifications. Miscellaneous purposes, objectives, goals, and priorities have been periodically stated, redefined, restated, modified, and implemented by managers. The central and fundamental goals of acquiring a better knowledge of the fauna and flora of Canada, although almost forgotten and/or neglected at times, remained a constant source of inspiration for curators and their staff when the degree of their involvement and activities was constrained by the availability of resources and by administrators who had little or no museological knowledge and a limited interest in the Museum.

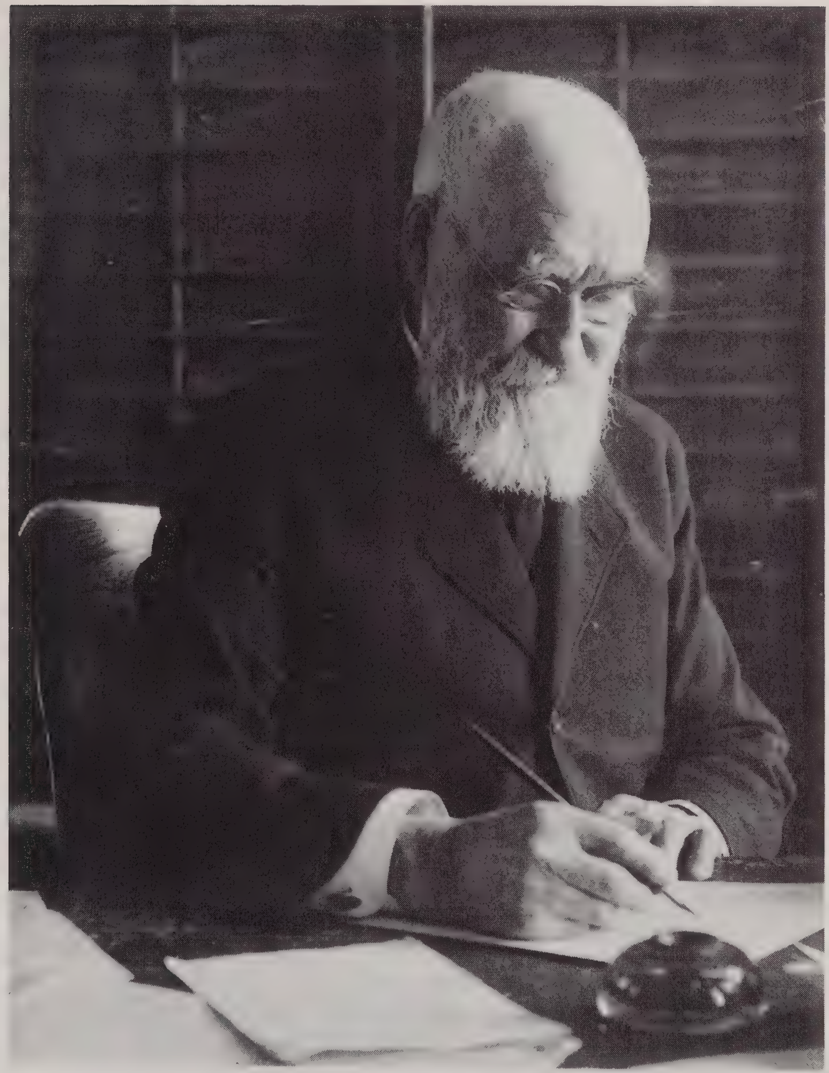
BIRTH OF ORNITHOLOGY AT THE MUSEUM

It is difficult to determine with certainty when ornithological activities started at the museum, but it can be safely assumed that they had their origin with the appointment of John Macoun (1831–1920) as botanist with the Museum Branch of the Geological Survey of Canada in 1882. Although hired as a botanist and primarily interested in botany, John Macoun, like many naturalists of his time, had broader interests and devoted much attention to other natural history subjects. He had a particular interest in birds and began collecting specimens for the Geological Survey as early as 1879 before his appointment with the Survey. These specimens and others collected later under his direction formed the initial nucleus of the museum's collections. In addition, Macoun's early ornithological work contained observations recorded during his numerous travels as a member of various expeditions and exploration parties between 1871 and 1882. During that period he travelled extensively in western Canada, including an important survey expedition to British Columbia in 1875. The main purpose of this major exploration was to assess the land in relation to its potential for agricultural purposes and to evaluate the possibilities of running a railway from eastern Canada to the Pacific coast (Macoun 1979, Waiser 1989).

In 1887 Macoun's promotion to the position of Survey Naturalist with the Geological Survey brought him a formidable responsibility: inventorying the plant and animal life of more than half a continent. In order to achieve this task, he concentrated on collecting representative specimens over wide areas (Waiser 1989). He was supported in this effort by his son, James M. Macoun (1862–1920), who had been hired in 1883 as his assistant, and by a remarkable field collector, William Spreadborough (1856–1931). In spite of the limited resources available to John Macoun, Spreadborough was employed to participate in, and conduct, field surveys in Canada for many years. Spreadborough's long and valuable contribution and association with the Macouns and the Museum ended with James Macoun's death in 1920. He was an important but relatively unknown pioneer contributor to the knowledge of bird distribution in several parts of Canada (Taverner 1933).

Extensive field surveys undertaken in Canada until 1908 established the national ornithological collections on a sound basis, recorded new data on bird distribution and ecology, and resulted in the publication of the first comprehensive work on the birds of the country, *Catalogue of Canadian Birds* (Macoun and Macoun 1909). This volume became a landmark in Canadian ornithology because it was the first detailed work to list and document the occurrence of all species of birds known to have occurred in Canada up to that time. In addition, it gave information on the distribution of each species based on published data. It also incorporated new unpublished records resulting from field work by the Macouns, from information obtained through correspondents in many regions of Canada, or from naturalists hired to undertake avian surveys and make collections of specimens. The book also summarized the general information available on Canadian birds and included notes on nesting, ecology, habitats, seasonal status, and migrations.

After the publication of this work, the Macouns concentrated on botany and published little on birds, except for the French edition of the *Catalogue* (1915). John Macoun's retirement in 1912 probably accounts a great deal for this shift in priorities. At the time of Macoun's retirement, the national ornithological collections included 6400 study skins, and about 1000 clutches of eggs and 100 nests (Figure 1). John Macoun recognized the importance of birds and their conservation and for several years before his retirement lobbied for the appointment of an ornithologist. After several frustrating attempts and repeated requests, his tenacity and the strong support which he generated among naturalists across the country for the creation of such a position were rewarded with approval for the appointment of a naturalist whose main function would be to conduct ornithological studies and work on bird exhibits at the museum.



John Macoun
1831 — 1912

Fig. 1. Professor John Macoun, the first naturalist with the Museum Branch of the Geological Survey of Canada. [Geol. Surv. Can., Neg. No. 31874].

Fig. 2. Professor John Macoun and P. A. Taverner, Ottawa, Ontario, circa 1912. [Can. Mus. Nat., Neg. No. J–5535].

THE RISE OF ORNITHOLOGY AT THE NATIONAL MUSEUM OF CANADA

With the establishment of a position of ornithologist at the museum in 1911, the first of its kind in any department of the Government of Canada, the study of birds would gain a popularity and importance surpassed in no other natural science. Percy Algernon Taverner (1875–1947) was appointed in 1911 and received the support of many prominent naturalists including J. H. Fleming of Toronto. Until his retirement in 1942, P. A. Taverner, as he signed his writings, pursued a very active and distinguished career. He was interested in the distribution of birds in Canada and continued the efforts of the Macouns by organizing survey parties to obtain the information and specimens necessary to describe accurately the breeding distribution of all species of birds found in Canada. In order to acquire this information effectively and rapidly, Taverner established a network of correspondents. He was successful in hiring a number of competent collectors and naturalists to explore the least known areas of the country. In this manner, the field work of J, D. Soper in the Northwest Territories, particularly on Baffin Island, in 1924, 1925, 1926, 1928–1929, and 1931 was supported wholly or in part by the Museum and yielded much new original material on bird distribution in remote and unexplored regions. Similarly, H. M. Laing's field survey activities for the Museum from 1921 to 1926 in western Canada (Saskatchewan, Cypress Lake; British Colombia, Okanagan Valley; Yukon, Mount Logan; Alberta, Belvedere; and the North Pacific) (Mackie 1985) resulted in valuable series of specimens and much new data on the breeding birds of those regions.

In recording as accurately as possible the distribution of birds in Canada, Taverner himself pursued a dynamic field survey program in many parts of the country. In order to have access to the large quantity of data

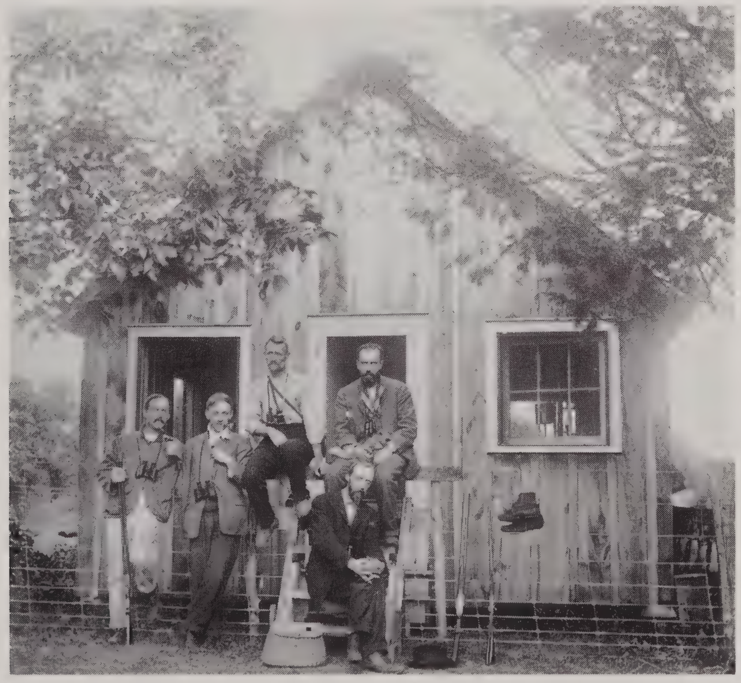


Fig. 3. P. A. Taverner (sitting in front) with members of the Great Lakes Ornithological Club [Left to right: J. S. Wallace, B. H. Swales, W. E. Saunders, J. H. Fleming], Point Pelee, Ontario, 3 October 1909. [Can. Mus. Nat., Neg. No. 60386].

which were available on bird distribution, he conceived an astute and unique system of maps and cross reference cards through which it would be possible to rapidly and accurately obtain information on the distribution of all the birds of Canada. This system, which now contains several hundred thousand records, is still in use and continues to be an exceptional source of information.

During his museum career, Taverner published nearly 300 articles and books. The diversity of topics treated shows his broad ornithological

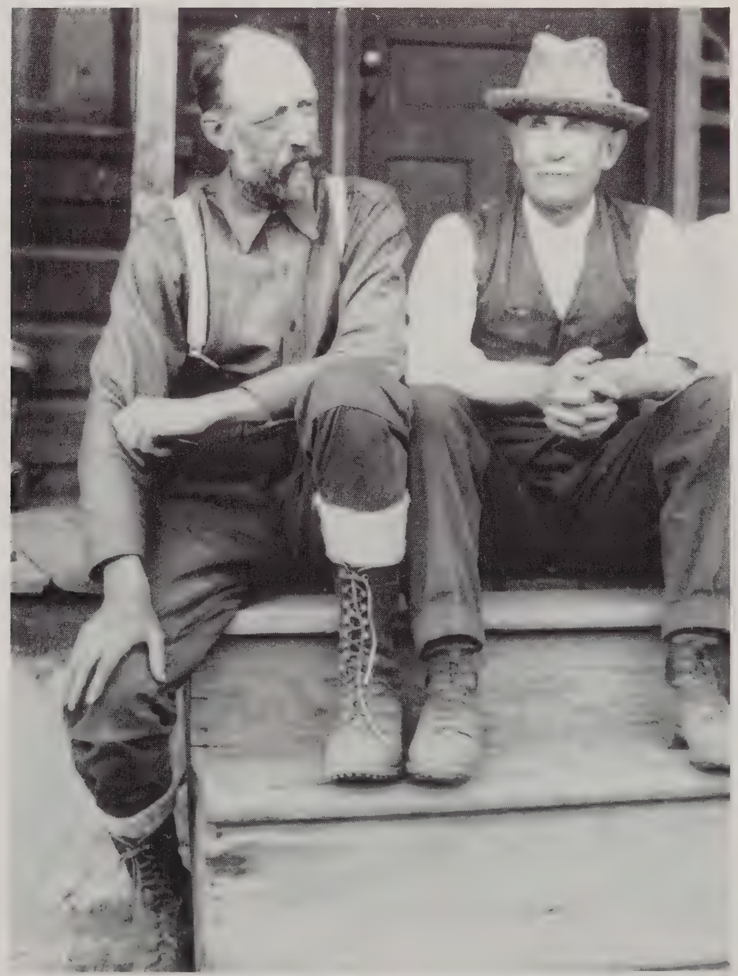


Fig. 4. P. A. Taverner (left) with Allan C. Brooks in the Okanagan Valley, British Columbia, May 1922. [Can. Mus. Nat., Neg. No. 56275].

interests and knowledge: distribution, taxonomy, nomenclature, vernacular names, migration, banding, conservation, economic aspects of birds, food habits, effects of contaminants, and behavior. His books were however the most influential of his publications. The first one, *Birds of Eastern Canada* (1919) was followed by a French edition, *Les Oiseaux de l'Est du Canada (1922)*. These were followed by *Birds of Western Canada* (1926) and *Birds of Canada* (1938). These books are profusely illustrated with Taverner's own black-and-white line drawings and numerous color plates by several artists, the most famous being Allan Brooks (Laing 1979). The text is easy to read and written in a pleasant style, yet is comprehensive and has detailed descriptions of the species as well as field marks, nesting information, distribution summaries, and notes on economic values of the birds. These distinctive traits have contributed to making these books popular with the general public and to popularize ornithology in Canada.

Taverner's role as the first curator in ornithology at the museum was important for two main reasons. First, he contributed significantly to the creation of the first large exhibits on birds at the museum by taking an active part in their design, selecting their themes, procuring specimens, sharing his expertise, and in supervising the completion of the work at all stages. Second, he played a capital role in the establishment and initial development of the national ornithological collections.

At the time of his appointment in 1911, the ornithological collections comprised about 6000 specimens (Figure 5). He persistently acquired new specimens during his 31-year tenure, as a result of the field work he undertook in many parts of Canada, from survey parties commissioned by the museum, and from exchanges, purchases, and gifts. He succeeded in expanding the bird collections during a difficult economic period overshadowed by constant and serious budgetary restraints that would have discouraged the activities of most curators. When he retired in 1942, there were more than 30,000 bird specimens at the National Museum, representing most regions of the country, with a series of specimens from regions critical to the study of geographic variation.

In addition to his official functions, Taverner encouraged naturalists and ornithologists to pursue their interests and gave many of them sound advice. He always demonstrated a remarkable foresight in his professional endeavours. He also participated in ornithological activities in Canada and elsewhere in North America as a member and active participant in the affairs of major ornithological societies. In 1926, he accepted the responsibility of hosting the 43rd stated meeting of the American Ornithologists' Union (AOU) in Ottawa, the only time the AOU met in Ottawa.

He was very concerned about conservation and became instrumental in the creation and development of bird sanctuaries. The best known is Bonaventure Island off the Gaspé Peninsula, Quebec, famous for its large

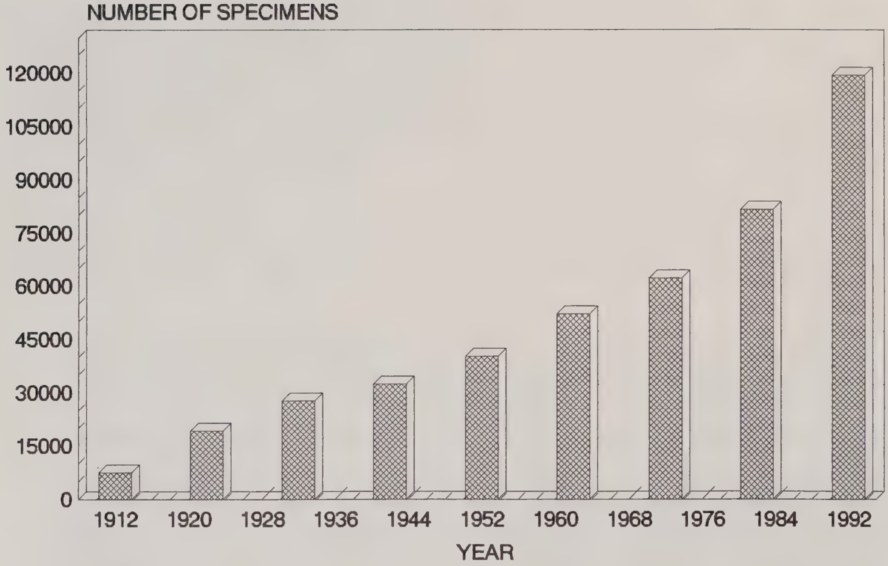


Fig. 5. Growth of national ornithological collections at the Canadian Museum of Nature between 1912 and 1992.

Northern Gannet (*Morus bassanus*) colony. Similarly, his influence was important in the establishment of a national park at Point Pelée in extreme southern Ontario. To summarize, P. A. Taverner was not only one of the leading scientists of the National Museum in the first half of the 20th century, but also the foremost Canadian ornithologist of the period (Ouellet 1987, 1988b; Ouellet and Godfrey 1980).

A PERIOD OF CONSOLIDATION

A short time before Taverner's retirement, and in spite of war-time restrictions, the museum hired an Assistant Zoologist. Austin L. Rand (1905–1982) accepted this position in February 1942 and divided his time almost equally between ornithology with P. A. Taverner and mammalogy with R. M. Anderson. He soon started an intensive field studies program in western Canada. In the summers of 1943 and 1944, taking advantage of the construction of the Alaska Highway and the Canol Road, he explored the southern half of those previously inaccessible vast regions. In 1945, he conducted field work in southern Alberta. He was promoted to Associate Zoologist in April 1946 and to Acting Chief of the Biological Division a few

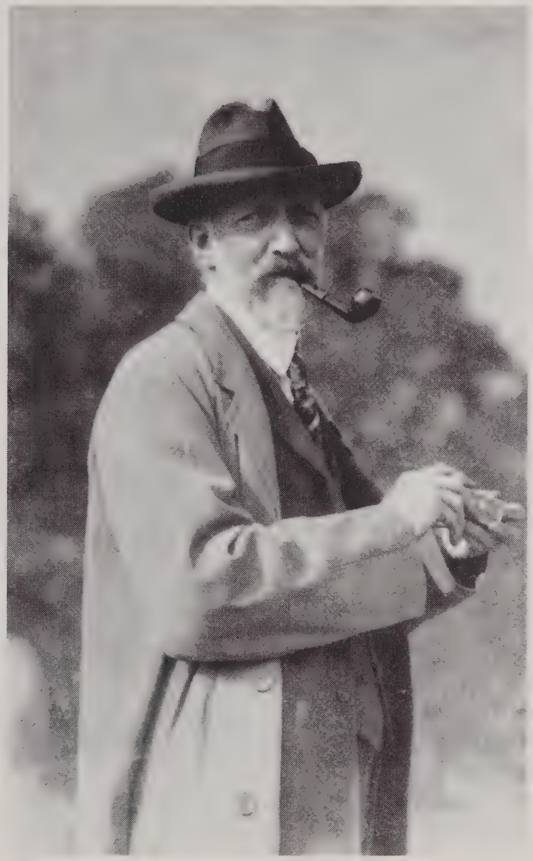


Fig. 6. P. A. Taverner a few years after retirement, Ottawa, Ontario, about 1946. [Can. Mus. Nat., Neg. No. 100028].

months later. After six years at the National Museum of Canada, Rand resigned in July 1947 to accept the position of Curator of Ornithology at the Field Museum of Natural History in Chicago (Godfrey 1988, Traylor et al. 1984). During his tenure at the National Museum, considering war-time constraints, Rand was amazingly productive. In addition to contributing significantly to the mammal and bird collections (Fig. 5), preparing reports on birds and mammals for government agencies in Canada and the United States, and serving as the ornithology associate editor for *The Canadian Field-Naturalist*, he authored or co-authored nearly 50 publications on birds and mammals (Cook and Godfrey 1988). He was interested in all

Fig. 7. A. L. Rand (entering truck), near Mile 36 on the Alaska Highway, summer 1944. [Can. Mus. Nat., A. E. Porsild, Neg. No. 98123].

aspects of birds especially evolution, behavior, and ecology, in addition to systematics, taxonomy, and distribution.

A PERIOD OF ASSERTION

In February 1947, six months prior to Rand's move to Chicago's Field Museum, the National Museum of Canada appointed W. Earl Godfrey as Biologist. Soon after his appointment, Godfrey started a long series of field surveys in various parts of Canada to obtain new information on bird distribution and representative specimens for taxonomic studies. He published extensive reports and several taxonomic papers on the results. He conducted field work in Quebec, Lake Mistassini and Lake Albanel (1947), Lake St. John (Godfrey and Wilk 1948), western and southern Saskatchewan (1948), southern Yukon (1949), central western Alberta (1950), southern Manitoba (1951), southern Quebec and Prince Edward Island (1952), southern British Columbia (1953), Cape Breton Island

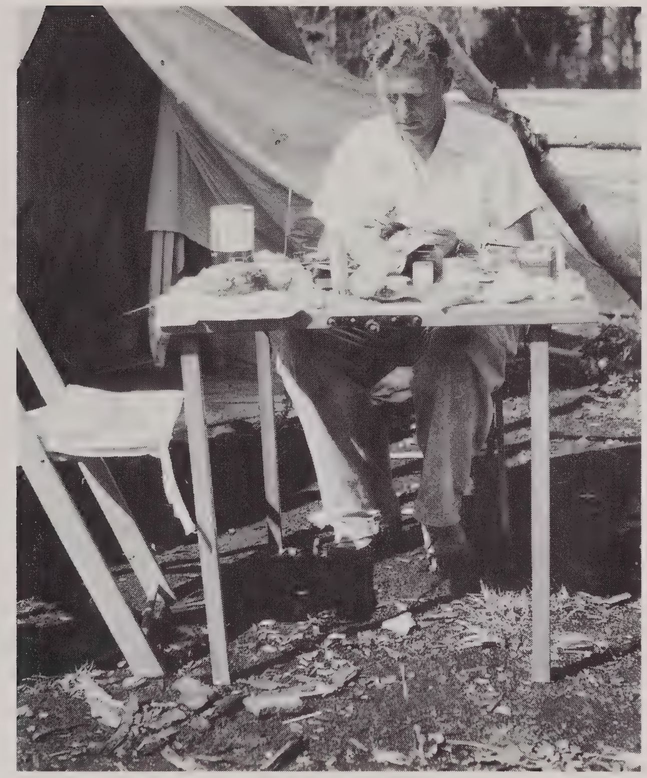


Fig. 8. W. Earl Godfrey preparing specimens in the field, Overflowing River, Manitoba, July 1951. [Can. Mus. Nat., Neg. No. 1951–J–1].

(1954), southern Quebec (1955), Prairie Provinces (1956), New Brunswick (1957), Alberta and British Columbia (1964), Abitibi region of Quebec (1965), central Ontario (1966), Ontario and Saskatchewan (1967), and British Columbia (1969). He directed or commissioned survey parties and expeditions in all parts of Canada from Ellesmere Island to southern Quebec, and from Newfoundland to British Columbia to obtain material for taxonomic studies and to document more accurately the distribution of birds in Canada. These field studies resulted in an extensive series of papers dealing with the distribution and taxonomy of birds, and in a number of taxonomic revisions (Godfrey 1949, 1950, 1951, 1952, 1953, 1956, 1958, 1968).

Concurrently, Godfrey encouraged numerous naturalists, explorers, and ornithologists to survey areas in which they were travelling, to donate their specimens to the museum, and to publish their results. The museum published reports in its various publication series that contributed to a bet-

Fig. 9. W. Earl Godfrey, National Museum of Canada, Ornithology Section, May 1953. [Can. Mus. Nat., Neg. No. J2036].

ter knowledge of the Canadian bird fauna and its taxonomy. The most prolific contributor of this period was T. H. Manning, who in addition to adding important collections, published extensively on the distribution and taxonomy of birds from remote arctic regions, including the Adelaide Peninsula, Prince of Wales Island, Twin Islands, and Banks Island

Godfrey's work culminated with the publication of the first edition of *The Birds of Canada* (1966), followed by a French edition *Les oiseaux du Canada* (1967). This work incorporated all the available information on bird distribution in Canada as well as the results of numerous expeditions and surveys undertaken by Godfrey himself or under his direction. Revised and updated editions were published in both official languages (Godfrey 1986a,b). The color illustrations of both editions of this authoritative book are the work of John Crosby who, particularly in the revised edition, has reached a rare level of excellence. *The Birds of Canada*, without doubt the most popular reference on birds in Canada, is already in its fifth printing with a sale of over 200,000 copies. In addition to serving as ornithology

Fig. 10. T. H. Manning, Manitoulin Island, Ontario, spring 1982 [courtesy of Douglas Perkins].

editor of the *Canadian Field-Naturalist* for over 30 years, Godfrey maintained a close contact with the amateur community that provided him with distribution records which allowed him to update the information in his books. Although retired since 1976, Godfrey, as Curator Emeritus (Ornithology), pursues his research in avian taxonomy, particularly that of arctic gulls.

In 1959, S. D. MacDonald was hired as Assistant Curator in the Ornithology Section and took part in several expeditions and field surveys in poorly known arctic regions. He travelled widely and the results of his work appeared in publications where new data on the ecology, behavior, and natural history of arctic species formed an important component. MacDonald became Curator in the newly established Ethology Section in 1966 and pursued studies on the behavior of a number of arctic and western species, focusing on tetraonids such as the Rock Ptarmigan (*Lagopus mutus*) and Spruce Grouse (*Dendragapus canadensis*), and arctic gulls including the Ivory Gull (*Pagophila eburnea*), and Ross's Gull (*Rhodostethia rosea*). He identified Seymour Island, a small island off

Bathurst Island in the Northwest Territories, as an important breeding area for Ivory Gulls and succeeded in having it designated a bird sanctuary. He was also instrumental in establishing Polar Bear Pass on Bathurst Island as Canada's first National Wildlife Area. He retired from the museum in 1990.

THE CONTEMPORARY PERIOD

Henri Ouellet was appointed Assistant Curator in the Ornithology Section in May 1970 and Curator in December 1976. His main research and ornithological interests are in distribution, zoogeography, and systematics, but he has published also on ecology and behavior (Ouellet 1969; 1970a,b; 1971; 1974a,b; 1977; 1990a,b,c; 1991). From 1970 to 1985, he conducted and/or directed over 20 ornithological surveys in various parts of Canada, from Newfoundland and Labrador to the Yukon, and from Ellesmere Island, Northwest Territories, to extreme southern Quebec, with a special emphasis on the Quebec-Labrador Peninsula. He has conducted also field investigations in the Lesser Antilles, Guyane française (French Guiana), Argentina, and Venezuela for studies on the systematics and evolution of selected Neotropical Emberizine genera.

Ouellet has been interested in establishing a French nomenclature for North American birds and has published lists of French names (Ouellet and Gosselin 1983, Ouellet et al. 1991). In 1982 he was appointed Secretary General of the 19th International Ornithological Congress held in Ottawa in June 1986, and was responsible for its organization. This task also included the editing of the proceedings of the Congress (Ouellet 1988a). He has been involved in miscellaneous ornithological and museological organizations (Ouellet 1985, 1986), served in various capacities on committees of these organizations and societies, and has been a member of the Committee on Classification and Nomenclature of the American Ornithologists' Union (AOU) since 1983.

Between 1970 and 1991, Ouellet was instrumental in enhancing the development and expansion of the national ornithological collections through field collecting, exchanges, acceptance of gifts, and purchases. Particular emphasis was placed on filling gaps in the geographic representation of Canadian material, acquiring specimens in particular groups poorly represented in the collections, and on broadening the global geographic representation of specimens, particularly from the Neotropics (Fig. 5). In August 1991, following a managerial decision to implement another reorganization, all curatorships at the Canadian Museum of Nature were abolished. Most curators thus became research scientists in their area of specialty with only an "intellectual" advisory role regarding the national collections.

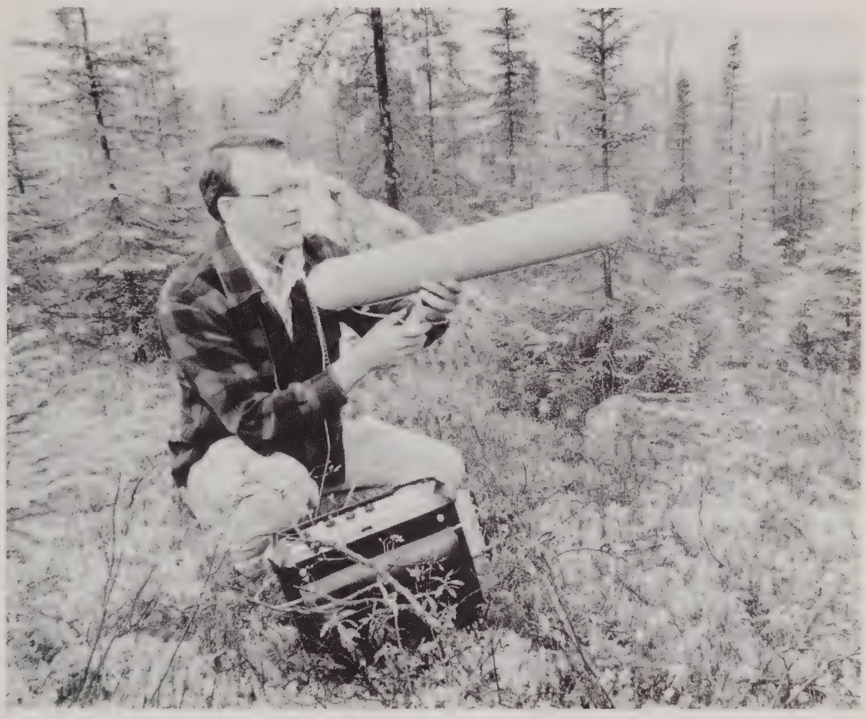


Fig. 11. Henri Ouellet, recording songs, near LaGrande, James Bay region, Quebec, 17 June 1983 [personal files].

THE FUTURE

In spite of recent changes, ornithology as a discipline will probably continue to occupy a significant place at the museum, but its future role is uncertain and conditional to managerial priorities and decisions. Ornithological research may have a more prominent role than in the past only if management supports it with the appropriate resources to create a dynamic and functional research group that could exploit the most recent technology and methodology to investigate long-standing systematic and evolutionary problems. On the other hand, the future of collections is as uncertain, particularly if their development in a rational progression along carefully planned directions is left in the hands of mere caretakers. The responsibility for their long-term safety, use, and expansion must return to active scientists.

In July 1993 the directorate of the museum submitted a plan to the board of trustees whereby research in certain disciplines, namely a few areas of botany and the "land vertebrates," would be abolished because "enough is known" in those disciplines. The savings of funds realized in this manner would allow management to give the museum a new orientation. This ill-conceived proposal was adopted by a board of trustees where the majority of the members are uninformed about the importance of plants and land vertebrates and about the purposes of a national natural history museum at a time when studies on the biodiversity of Canada occupy such a significant place in conservation.

In conclusion, Canada's National Museum of Natural History does no longer count ornithology as one of its active research disciplines. Its extremely valuable ornithological collections are now in the hands of unqualified managers and of technicians, and their future is in peril. There appears to be no hope that the abolished disciplines will be reestablished under the present regime and conditions. The museum has now regressed beyond what it was in 1911 when its first ornithologist was appointed because, contrary to what prevails now, there was at that time a strong desire to increase fundamental knowledge and a deep curiosity about the fauna and flora of Canada.

ACKNOWLEDGMENTS

I wish to extend my thanks to Dr. W. Earl Godfrey for reading the manuscript and offering valuable suggestions, and to Michel Gosselin and David Gill for supplying data and other information.

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13

A History of Ornithology at the Royal Ontario Museum

Jon C. Barlow[1]

ABSTRACT.—Origins of ornithology at the Royal Ontario Museum are rooted in late-19th century activities at the University of Toronto, where Professors Ramsay Wright and B. A. Bensley strongly advocated creation of a provincial museum in the City. In 1913 the Province of Ontario established the Royal Ontario Museum (ROM) in Toronto consisting of five separate museums. Bensley became Director of the Royal Ontario Museum of Zoology (ROMZ), which contained the fledgling Ornithology Department. The first ornithologist hired by ROMZ, Lester Snyder, arrived from Iowa in 1917 and became a major force in research, collection, and exhibit development in the Museum for 45 years. He and colleagues Jim Baillie, Terry Shortt, Cliff Hope, and businessman J. H. Fleming were the principals in ROM Ornithology during its inventory period. Faunal surveys, mostly in Ontario, collections building (from 5000 to 100,000 specimens during Snyder's tenure), and an exhibition program, were the dominant activities of the Museum's first ornithologists.

Since 1965, Department Heads J. C. Barlow (1965–1976) and A. J. Baker (1976–) have overseen an increase in staff from 4 to 10 and further developed the size and scope of traditional and specialized collections, making the skeleton collection the world's largest at ca. 43,000 specimens. They initiated research on song, cultural evolution, systematics and evolutionary genetics of birds; taught courses in ornithology and biostatistics; supervised the research of ca. 35 graduate students; facilitated gallery work in the 1980s; and obtained financing for labs and requisite equipment devoted to studies of molecular genetics and vocalizations of birds.

The Royal Ontario Museum (ROM) is an educational, research and service museum, with broad collections and facilities in life and earth sciences, and cultural and heritage disciplines with nearly 500 employees, including

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75 research curators. It is the largest and, in some fields, the only museum in Canada with a world-wide research mandate. The Department of Ornithology is currently the museum center in Ontario of "molecular-based" research on the systematics and evolution of birds. Ornithologists at the ROM share with colleagues in the life sciences at the Museum and in Zoology, University of Toronto (UT), the Laboratory of Molecular Systematics operated by Zoology but housed in the ROM.

The ROM and the University of Toronto.—ROM ornithology has had strong historical ties with biologists at UT dating to the mid-19th century. Events presaging the modern Museum started with scientists and educators mostly associated with the University. When the ROM came into being in the early 20th century, nearly all it's administrators and researchers were from the academic ranks of the University.

The ROM sought greater independence from the UT in the mid-1940s, calling for a change in the Provincial Museum Act to permit direct funding of the ROM by the Province rather than through the University. Proposed in 1946 by the Associate Director (ROMZ) Lester Snyder, and favored by the ROM administration, this proposal was ignored by both the Ontario Government and the University, as they created a new Provincial Museum Act (1947), which gave complete control of the Museum to the University by making the ROM one of its departments (Dickson 1986). The ROM was not to gain independence in funding and governance until 1968. Impetus for the move came from Peter Swann, a former Keeper of Archaeology at the Ashmolean Museum in Oxford, who led the ROM with a brief (1967–1972) but meteoric directorship.

Ornithology benefitted greatly from a special institutional renaissance, spearheaded by Swann, that flourished in the ROM in the late 1960s. New monies came from the provincial and federal governments and the private sector, financing major increases in research, collection storage, and gallery space. Swann also fostered a burgeoning of museological, managerial, and research activities in the Museum. The enhanced facilities and funding required creation of new staff positions which brought new talents into the institution.

A HISTORY OF ORNITHOLOGY IN TORONTO

Roots of Ornithology at the ROM.—The acquisition of natural history specimens, some transferred later to the ROM, began as early as 1849 at the University of Toronto. In 1857, the Reverend Professor William Hincks, appointed Chair of Natural History in 1853, started cataloging bird and mammal specimens already in hand. These collections were housed in an early natural history museum in West Hall of University College on the St. George (main) campus. A skilled taxidermist, George Hadgraft of London, England, was soon hired to help Professor Hincks and to acquire fresh specimens of birds. Hadgraft produced a number of mounts representative of the Canadian avifauna (Dymond 1940).

Hincks died in 1871, and was succeeded by Professor H. Alleyne Nicholson, who had an energetic two years (1872–1873), undertaking a much needed reorganization of the animals on display. When Professor Ramsay Wright assumed the natural history chair in 1874, the contents of the Museum, in quality and coverage, were equal to the highest standards of the day. Under his guidance the Museum gained a reputation as the finest of its kind in Canada.

Wright became Professor of Biology in 1887, but remained committed to development of the bird and mammal collections for the University Biological Museum. His belief that natural history specimens, especially birds, were important for scientific training of University students and education of the general public, coupled with his advocacy of a separate museum of zoology, were potent factors leading to the establishment of the ROM. When the ROM opened in 1913, the collection transferred from the University's Biological Museum included 5000 specimens of birds.

Upon Wright's retirement in 1912, Professor B. A. Bensley became Chairman of the Department of Biology at UT. Bensley joined others in requesting that the ROM Board of Trustees include a zoological museum in their new institution. The Royal Ontario Museum of Natural History (soon ROM Zoology) established in October 1913 was the last of five museums that collectively comprised the greater Royal Ontario Museum. Professor Bensley became the first Director of ROM Zoology.

The Museum Building.—The five museums were to be housed in a large building with an "H" configuration. A single four-story structure was the first building constructed, with its long axis at right angles to Bloor Street—an east-west thoroughfare demarcating the northern boundary of UT. The "H" was not completed until 1931–1933, when the Queen's Park wing and connecting stories to the west wing were finally built (Fig.1). The most recent ROM construction, finished in 1982, produced the tiered, glass-fronted Queen Elizabeth II Terrace Galleries north of the connecting building facing Bloor Street, and the Curatorial Center of nine floors, seven above ground and two below, south of the connector.

Housing Ornithology in the ROM 1913–1994.—In 1913, the zoological collections were given ca. 6500 sq. ft. of gallery space at the north end of the third floor in the newly opened Museum building. Of this, 500 sq. ft. housed Director Bensley's Office and the research collections of birds

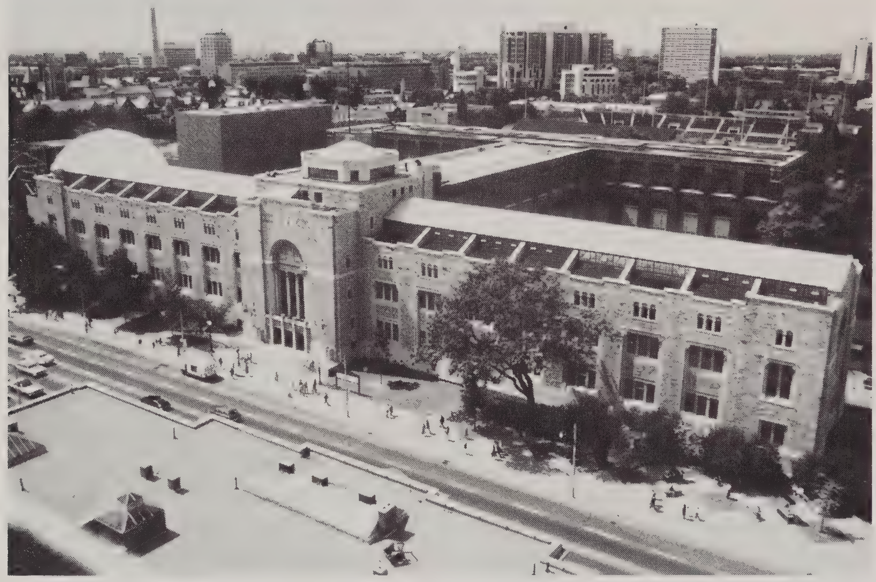

Fig. 1. The Royal Ontario Museum as it looked in about 1978 from a northeastern perspective. In the mid-background, the original building (opened in 1913), now the west wing, may be seen attached to the front wing built in 1931–32 by the "cross-bar" of the "H" configuration. The Curatorial Center and the Terrace Gardens wings now on the north and south sides of the cross-bar were yet to be added. To the immediate west and southwest are buildings of the University of Toronto.

and other animals, and a specimen cataloging area. Preparation of specimens occurred in a basement room of 540 sq. ft.

With the availability of the east wing in 1933, Ornithology, now a separate department, moved to new quarters there that eventually occupied 5200 sq. ft. A specimen preparation lab complete with a dermestid colony and walk-in freezer was established in the basement. In 1983 Ornithology moved a final time into 9500 sq. ft. encompasing the west end of the third floor in the new Curatorial Center and adjacent space in the newly renovated west wing.

THE INVENTORY ERA 1913–1965

The Early Collections.—Baillie (1938) notes 4400 skins and 600 mounts as the first ornithological holdings in ROMZ. He regarded the 1047 specimens from the Biological Society of Ontario and 1619 skins from the British Museum (Natural History), and two smaller lots from Dr. J. H. Garnier (612) and J. H. Ames (546) as the most important of the 10 separate collections represented. No staff-initiated field acquisition of birds occurred until after 1917, and in the interim staff concentrated on displaying bird mounts already in hand.

Lester L. Snyder (1894–1968).—In 1917 an American, Lester Lynne Snyder, a senior at the University of Iowa was hired as Technologist at ROMZ, becoming the fourth member of the "curatorial" staff. From early childhood, Snyder had collected eggs and nests; at 10, he learned taxidermy, and within two years a room in the family home had become a miniature museum. In high school, he decided on bird study in a museum as a career. At the University of Iowa in 1914 he majored in Museum Studies under Professor H. R. Dill, a museologist and natural historian, taking courses in museum techniques and ornithology as part of a liberal arts curriculum. He left Iowa a credit shy of graduation. Beginning his 46-year career at ROMZ on 17 September 1917, his responsibilities were to "direct development of exhibition and other phases of museum work in line with modern methods" (Dymond 1940:16).

After two years, Snyder became Technologist in the Gallery (1919–1925), and then Technologist in Ornithology (1925–1935). For 21 years he was involved in exhibition, administration, and public service, gradually shifting emphasis from collecting of birds for display, to acquisition as part of a faunal survey of Ontario. In 1935, the now independent Department of Ornithology was renamed the Division of Birds, and Snyder was promoted to Curator of Birds. He was appointed Assistant Director (1938–1949) and Associate Director (1949–1955) of ROMZ, although he continued his curatorial duties throughout.

Ontario, except for its southern-most parts and the work of a few isolated individuals, was "terra incognita" until the establishment of the ROMZ (Dymond 1940). Thus, the more than 8000 specimens from the faunal surveys were critical to defining ranges of birds over most of Ontario. In the summer of 1919, Snyder, E. B. S. Logier, an artist and herpetologist on staff since 1915, Professor E. M. Walker, Assistant Director ROMZ, and N. K. Bigelow made the first field trip for the fledgling institution to the vicinity of Port Sydney, Ontario (Fig. 2). For 11 weeks they collected birds and mammals for exhibition and insects for research, initiating the "inventory

Fig. 2. The personnel on the first ROMZ field trip, Port Sydney, Ontario, July 1919. From left to right: Professor E. M. Walker, L. L. Snyder, E. B. S. Logier and N. K. Bigelow.

period" of life sciences research at the Museum (Dickson 1986:52). Between 1919 and 1967, 40 trips that included bird work were undertaken in Ontario.

Lester Snyder's achievements are little spoken of today except by his former ROM colleagues. Although a subtle legacy, Snyder had a lasting impact on development of the research collections and on aspects of gallery design (Baillie 1969). Snyder's contributions indicate an activist's posture in promoting the study of birds and nature (Long and Barlow 1986, Barlow and Kozlovic 1994). He played seminal roles in the founding of nature clubs and societies. He was instrumental in establishing the Toronto-based Brodie Club in 1921, created for the serious study of natural science in an air of good fellowship, and in founding The Toronto Field Naturalists (1923), and the Federation of Ontario Naturalists (1931).

Snyder's contributions to the development of the research collections in the Museum were as follows: (1) he initiated faunal surveys of Ontario, frequently with participants from the ROM's other natural science departments; and (2) he forged strong friendships with owners of private collections of birds, who eventually gave or sold them to the ROM. Snyder obtained private collections from Hoyes Lloyd of Ottawa, J. A. Munro of British Columbia, and J. H. Fleming of Toronto. Lloyd's 4726 specimens came to the ROM as a bequest in 1984, and Munro's material (8461 bird skins) was purchased in the early 1960s. Both acquisitions contained many specimens from the U.S. and Canada. Most important in terms of size and diversity was the gift of more than 32,000 bird specimens in the will of Toronto businessman Fleming. The field parties at the behest of Lester Snyder had collected 35,000 skins, eggs and nests, and with donations, purchases and the bequest the study collections totalled nearly 100,000 specimens at the time of his retirement in 1963.

Snyder became an Elective Member of the American Ornithologists' Union AOU in 1929, and a Fellow in 1947. He also served for two terms on the AOU council, 1951–1953; 1959–1961. As a member of the Canadian inner circle of the AOU, the Appleton Club, which included J. H. Fleming, Hoyes Lloyd, W. E. Saunders, and P. A. Taverner, Snyder influenced policy making at several levels of government. He was honored internationally with his election in 1962 to the Committee of 100 of the International Ornithological Congress.

James L. Baillie (1904–1970).—Snyder worked alone on birds in the Museum until 1922 when James Little Baillie, then a teenager, was hired at the ROMZ as Assistant. Baillie, already an avid birder, became an enthusiastic apprentice of the museum profession, beginning fieldwork in July 1922 at Cedar Lake in Algonquin Park. This expedition was primarily to secure a black bear (*Ursus americana*) for a diorama to be executed by Snyder. Baillie was eventually to participate in 21 summer field trips spanning 45 years, the last in 1967 to collect vireos along a transect from Ontario to Alberta.

Baillie rivalled Snyder in variety of positions held in the ROMZ (and later the ROM). He became Cataloger from 1927 to 1947, and then was promoted to Registrar, serving until 1950. Next, he was Research Assistant (in Ornithology) from mid-1950 to 1958, Curatorial Assistant from 1958 to 1960, and was finally promoted to Assistant Curator, a rank held until his death in May 1970. After Snyder's retirement in 1963, Baillie was made Assistant Curator-in-charge, a responsibility maintained until September 1965.

Baillie and Snyder concentrated on collection development, mostly birds, but had responsibility for mammals until the early 1930s when E. K. Cross was hired as mammal curator. In the 1920s, Snyder and/or Baillie usually accompanied other ROMZ staff into the field, often on trips for fish, reptiles, amphibians, and arthropods, as well as birds and mammals. The multi-discipline camps established during the summer work were highly productive of specimens, but were also characterized by good spirit and camaraderie among the staff (Long and Barlow 1986). A brand of interdisciplinary cooperation prevailed in those times that served to maximize the meager resources of the participating disciplines to the benefit of all (Barlow and Flood 1983).

Although the two men worked together, each claimed different parts of the local ornithological scene. Jim Baillie, the consummate birder with a personal retinue of adoring birding comrades, wrote a nature column featuring mostly birds and birders around Toronto for many years for the old Toronto Telegram (the "Telly").

Baillie also encouraged developing bird artists, including Robert Bateman, Fenwicke Lansdowne, Glen Loates, and George McLean. He facilitated bird skin loans to artists and also gave them tutelage on the habits of local species. Baillie had a special flare for historical writing and produced papers on early Canadian naturalists and collectors with interest in birds. His favorite subject was Charles Fothergill (1782–1840), whom he regarded as Ontario's first real ornithologist.

Eventually, Baillie came to be regarded as a "Roger Tory Peterson" figure in Ontario, and his friends frequently vied for his participation in their own weekly birding adventures. His scientific and popular writings, numbering more than 300 titles, largely concerned occurrence, distribution, and breeding of Ontario birds (Baillie and Harrington 1937).

He became an Elective Member of the AOU in 1955 and was on the AOU council for the years 1960–1963. In 1967, he received the prestigious Canadian Medal from the Federal government in recognition of his contributions to natural history study in Canada.

James H. Fleming (1872–1940).—James Henry ("J. H.") Fleming (Fig. 3) served the development of ornithology in Ontario from his home in Toronto. The house at 267 Rusholme Road became a well known meeting place for local and out-of-town colleagues. Fleming, whose formal education ended with high school graduation, acquired an interest in birds in early life which Snyder (1941) believed to be self-generated. By age 12, Fleming had obtained his first specimens of birds, nests, and eggs; by 14 he had decided to build his own study collection. In 1889 he became a member of the scientific organization, now known as the Royal Canadian Institute, and by 1893 had been elected Associate of the AOU. Over the next 30 years, Fleming's reputation as an ornithologist and developer of a one-man museum grew substantially. By 1925, the museum occupied a 3-room annex built on the back of the main house.

Fleming, now well-known internationally, had gone to his first International Ornithological Congress in 1905 in London. He attended four more as Canada's official representative. He was elected Member of the AOU in 1901, a Fellow in 1916, served on council (1923–1926), was Vice-

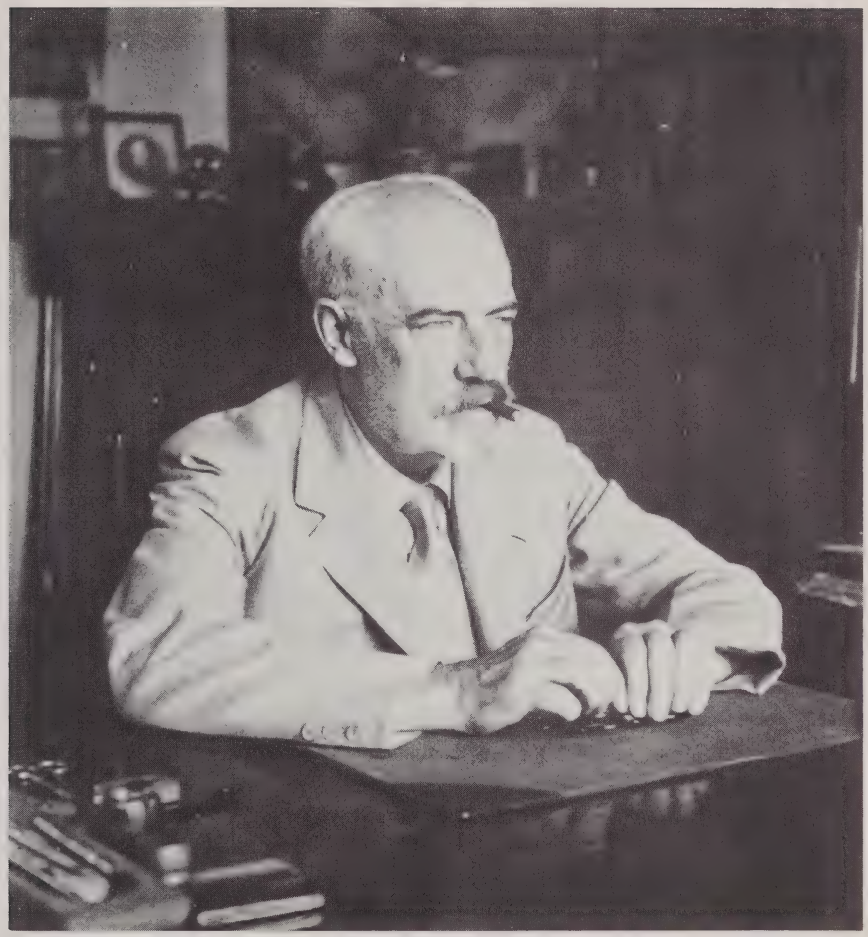

Fig. 3. J. H. Fleming about 1935.

president (1926–1932), and finally President (1932–1935). Other honors included appointment as Honorary Curator of Ornithology at the National Museum of Canada in 1913, and similarly Honorary Curator of Ornithology at the ROM in 1927.

From the outset, Fleming intended his private collection to go to a Canadian museum, and upon his death in 1940, the ROM received a bequest, fostered by his 20 years of friendship with Snyder, from his estate of 32,267 bird specimens. The collection contained 80% of the then recognized genera of birds, some types and many paratypes and topotypes, as well as many extinct and vanishing birds, especially from New

Zealand, including series of the Huia (*Heterolocha acutirostris*) and Owl Parrot (*Strigops habroptilus*). The Museum also received Fleming's outstanding personal library.

Terrence Shortt (1910–1986).—The advent of the 1930s included arrival at the ROM of two men who would complete the Museum's team of the next two decades. Terrence ("Terry") Michael Shortt came on staff in 1930. Peter Buerschaper (1994:196) characterized Shortt in the flush of his ROM career as "artist, ornithologist, collector, taxidermist, naturalist and custodian of several other museum positions all at the same time." In his native Manitoba, Shortt came to art early in life through tutelage from his mother, and by age 11 was seriously interested in birds. As a teenager, he studied at the Winnipeg School of Art, and was subsequently hired by a firm that illustrated the T. Eaton Co. catalogue, there being no career opportunities in wildlife art (Buerschaper 1994).

Years later, Shortt (1975) wrote in his autobiography how the offer of a position as an "Assistant" at ROMZ alleviated his frustration over not being able to study and paint birds in the wild. Overnight at the Museum, he found himself engaged in taxidermy, display work, and wall painting, and was soon able to participate in fieldwork and scientific illustration. His first expedition was in 1931 with a party collecting animals near Sault Ste. Marie. He obtained 131 of 397 bird specimens taken on the trip.

His field skills recognized, Snyder chose Shortt to make the ROMZ's first collecting venture outside of Ontario to Lake St. Martin in Manitoba. His next trip out of Province was to Alaska in 1936—the first bird collecting done by the ROMZ in another country. Ontario fieldwork followed in 1937, 1939, 1942, 1947, and 1948, but his trips to other parts of the globe became his signature work both with Ornithology and later with the "Art Department."

He left Ornithology in 1948 to become head and principal architect of the new Life Sciences Department of Art and Exhibits (LSDAE), remaining at the helm until retirement in 1976. He produced, sometimes almost singlehandedly, several outstanding dioramas and a number of smaller exhibits. His aptitude for painting live birds left him with few peers in Canada. His personal accessibility, combined with his immense talents, established him as a guru to many Canadian wildlife artists.

By the end of his career he had undertaken 26 field expeditions, 13 on behalf of the Ornithology Department, including a 3-month voyage in the eastern Canadian Arctic in 1938. In 1946 he made the ROM's only bird collecting trip to Latin America prior to the late 1960s. His lifetime fieldwork yielded 2592 bird specimens for the ROM. His post-1948 field activities were on behalf of exhibitions, but still yielded specimens for Ornithology from Trinidad, the Galapagos, India, and Kenya. In his 45 years at the ROM, he painted 53 wildlife posters, did 932 illustrations for 20 books, made 2700 field sketches of birds, and executed hundreds of drawings and paintings for Canadian, American, and European publications. He also found time to write several books, including the autobiographical *Not as the Crow Flies* (Shortt 1975), and to author or co-author more than 30 scientific papers on birds. One, concerning Baird's Sparrow (*Ammodramus bairdii*), remained the definitive work on that species until the late 1980s (Cartwright et al. 1937). He received many honors and awards for these accomplishments, including selection as an Elective Member of the AOU in 1944.

Clifford Hope (1910–1953).—The last regular in Ornithology in this period to arrive, Clifford Earnest Hope was hired in 1932. He was a native Torontonian who also had been a naturalist from early childhood. He had a collection of birds in his home, all taken with a slingshot. Specimen preparation as a child presaged excellence as a preparator as an adult, which secured for him his appointment to the ROMZ's technical staff. Hope started the bird skeleton collection, which became the nucleus of the present skeleton holdings. He eventually became Chief Preparator, Division of Ornithology at the Museum (Baillie 1954:348) (Fig. 4).

Beginning in 1933, Hope participated in and/or was in charge of 10 expeditions to collect birds. In Ontario these included several sites in the Hudson Bay drainage of the far north (Baillie 1954). Hope and Terry Shortt were at Fort Albany in the summer of 1942 when a Cree lad brought them the first specimen for Ontario of the White-winged Dove (*Zenaida asiatica*). The youngster had shot the vagrant bird while the two intrepid collectors sat unaware preparing specimens in their tent (Shortt and Hope 1943).

Hope collected in the United States only once. In six weeks in the summer of 1950, he obtained 270 bird specimens in Wyoming. He played a pioneering role in studies of effects on birds of DDT and budworm outbreaks after a temporary position in 1945 with the Ontario Department of Lands and Forests assessing effects of DDT spraying in Algonquin Provincial Park. Hope wrote 32 papers that included a major effort co-authored with Jim Baillie on birds summering immediately northeast of Lake Superior (Baillie and Hope 1947). Cliff Hope was 43 when he died on 31 March 1953.

The Close of the Inventory Period.—From the mid-1950s to 1965 Snyder and Baillie pushed on with their personal research projects, and in 1958, Snyder began work on a major summary of previous distributional studies of Ontario ornithology that continued into his post-retirement years, but was never completed. Don Baldwin, a young Britisher who had

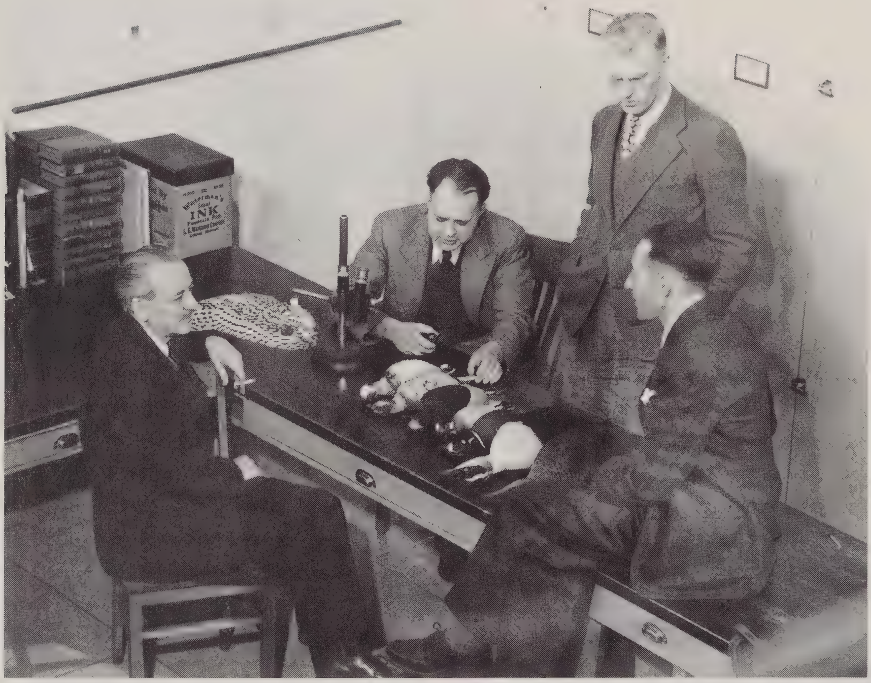

Fig. 4. The first team of ornithologists of the Department who worked together between 1930 and 1950, as seen in the old Bird Room in the east wing about 1947. From left to right: Lester L. Snyder, Clifford E. Hope, James L. Baillie (standing), and Terrence M. Shortt.

once worked at Slimbridge under Sir Peter Scott, started on staff in Ornithology in 1962. As a part of Snyder's research, Baldwin was sent to survey the avifauna of the Sutton River area of southern Hudson's Bay, which he did in 1962 and 1964, moving northwestward along the coast of the Bay to the Winisk River in 1965. In the meantime, Snyder retired in 1963 and was succeeded for the next two years by Baillie.

Acquisition achieved a last glorious moment under the old regime thanks to the perseverance of Baillie. In 1964, he organized a fund-raising campaign for the purchase of Great Auk (*Penguinus impennis*) and Labrador Duck (*Camptorhynchus labradorius*) specimens, neither of which was represented at the time by skins or whole mounts in any Canadian Museum. By early 1965, $10,500 had been raised and mounts of the two were purchased from Vasser College; the specimen of the auk was reputed to have belonged to Audubon.

In the first 50 years of the ROM, the major scientific publications in ornithology were faunal surveys. Four publications from those years merit special note. The first of these was an historical study titled *The Passenger Pigeon in Ontario* by Margaret Mitchell (1935), which dealt with the impact of *Ectopistes migratorius* on Ontario history. Two were books by Lester Snyder with artwork by Terry Shortt. They were summaries of years of observations and collecting in Ontario and adjacent lands to the north by Snyder and his colleagues. One, *Ontario Birds* (Snyder 1951), was chosen book of the year by the Toronto Daily Star; the other was *Arctic birds of Canada* (Snyder 1957). The fourth book mentioned above was *Where is that Vanished Bird?* by Paul Hahn (1962). Hahn, owner of a Toronto firm selling pianos, spent years searching the literature and corresponding with museums that might possess specimens of Passenger Pigeons, Labrador Ducks, Great Auks, Whooping Cranes *(Grus americana),* Carolina Parakeets *(Conuropsis carolinensis),* or Ivory-billed Woodpeckers *(Campephilus principalis).* Whenever possible, Hahn encouraged owners of Passenger Pigeon mounts to donate them to the ROM. With acquisition continuing, the ROM has 146 specimens of this species.

THE POST-INVENTORY ERA: 1965 TO 1976—A TIME OF TRANSITION

By the mid-1960s, with the faunal assays of Ontario nearly completed, Ornithology was ready for a change in direction and scope. Those trained in a quantitative approach to bird studies, and with some skill in systematics, were now called upon to join a new era in the development of the Museum, one that would see in the ROM, some 25 years later, an allozyme assay laboratory for general users in the life sciences, and by 1988, a laboratory of molecular genetics in the Department of Ornithology.

Jon C. Barlow (1935–).—Jon Charles Barlow came to Ornithology as Head and Curator in mid-1965 upon completion of doctoral studies in Zoology at the University of Kansas. Because the ROM was still a part of the University of Toronto in 1965, he was jointly hired by the Museum and the Department of Zoology. Earlier, work with the University of Kansas Museum of Natural History, and the American Museum of Natural History had afforded him curatorial field training in the U.S. and Latin America where he had become well versed in collecting and bird study techniques. Barlow's (1962) Master's work concerned the natural history of Bell's Vireo (*Vireo bellii*), but he examined the ecology and zoogeography of the modern mammals of Uruguay for his doctorate (Barlow 1965).

From the start, Barlow instituted new curatorial procedures in the collections and hired additional staff. Departmental personnel rose from four in the late 1960s to the present level of 10 in the early 1970s. He also inaugurated a worldwide fieldwork program to increase geographic coverage of the skin collection and, beginning in 1966, to further develop skeleton and spirits holdings. From the days of Cliff Hope, the skeleton collection had grown to nearly 1100 specimens representing several hundred taxa. Only 11 "alcoholics" specimens were in hand when expansion efforts began.

Donald Baldwin was sent to Belize (British Honduras) in the spring of 1966 to begin acquiring anatomical specimens of Latin American birds before leaving the ROM for a teaching position. Six visits were made to Belize by staff between the mid-1960s and early 1990s to collect selectively, study vireos, and investigate bird distribution.

Rolph Davis took over as technician following Baldwin's departure from the ROM in 1966. He did fieldwork in Belize and at Moosonee in northern Ontario in 1966 before departing in 1967 for doctoral work on loons (Gaviidae) at the University of Western Ontario.

The staff diversifies: James Arthur Dick (1938–).—In 1966, James Arthur ("Jim") Dick was hired as the Department's first Curatorial Assistant. A native Missourian, he also started graduate work with Johnston at the University of Kansas, but did an M.Sc. in Zoology at the University of Toronto with Barlow. Over the years, he acquired birds for the Department in Illinois, Kansas, Missouri, New Mexico, Texas, Ontario, New Brunswick, western Canada, Yukon, Belize, French Guiana, Guyana, Venezuela, the West Indies, Rhodesia (Zimbabwe), and the Transvaal (South Africa), adding nearly 7000 specimens to the research holdings. In recent years, he has assumed complete responsibility for the day-to-day curatorial attention in the research collections. He is currently Collections Manager and in charge of departmental specimen loans.

The First Research Associates.—In 1967, Barlow appointed two Research Associates to the Department. Reverend R. Charles Long (1930–1986) was a missionary in Malawi (Nyasaland) for 10 years beginning in the 1950s, becoming an expert on its birds. As a teenage birding protégé of Jim Baillie's, he had a lengthy history with the Department. Upon return from Africa, he presented the Museum with a collection of 1500 bird specimens from Malawi, giving ROM the largest Malawi collection in North America.

Dr. Howard G. Savage (1913–), a retired pediatrician with an interest in avian skeletons, especially from archaeological sites, joined the Department in the same year as Long as it's only paid Research Associate.

Subsequently, he acquired a teaching position at UT in Anthropology, instructing on bone identification in his course in zooarchaeology. At 81 Savage continues to publish on bird bones from middens.

Glenn Murphy (1947–), the senior technician.—Glenn Murphy came on staff as a Junior Technician in October 1967. He used his emerging skills in newly learned specimen preparation and taxidermy, and rose through the technician ranks to Technician 4. He currently is in charge of the specimen preparation lab. His present responsibilities include specialized specimen preparation and tissue extraction for the genetic assay of birds.

Ross James (1943–).—Ross David James began a dual career in the ROM in 1966 as one of Barlow's first graduate students in Zoology at UT, and as a part-time employee in the Museum. He displayed critical interest in conservation problems, of which birds were an important part. His M.Sc. addressed foraging behavior of forest vireos in Ontario. In 1973, he completed doctoral research on the comparative behavioral ecology of Yellow-throated (*Vireo flavifrons*) and Solitary (*V. solitarius*) vireos. Concurrently, in the ROM he had begun a progression through the technician and curatorial ranks. James served as a technician in Ornithology in 1967–1968 and as Research Assistant in 1968–1970. He then moved into the curatorial ranks in 1970–1972 as a Curatorial Assistant, Assistant Curator from 1973–1979 and Associate Curator, 1979 to the present.

The arrival of the "Californians."—In 1969, Carol (Meade) Goodwin (1941–) joined the bird staff as Curatorial Assistant. She had just finished an M.S. at the University of Arizona with Steven Russell on migratory behavior in the Elf Owl (*Micrathena whitneyi*). Carol helped with several important temporary exhibits and with the development of the skeleton collection before she moved on to the Design Department in the ROM in 1973.

This pre-bureaucracy and pre-union time in the ROM that facilitated ready hiring of new staff allowed expansion of the curatorial ranks, beginning in 1967 with the arrival of Dennis Michael Power (1938–). Another Californian, he had received a doctorate at the University of Kansas studying with Richard Johnston. Power's multivariate assay of geographic variation in the Red-winged Blackbird (*Agelaius phoeniceus*) had prepared him to introduce quantitative methodology to the Department. His career at the ROM began with a five-week field trip to the Zagros mountains of western Iran, which took advantage of the Museum's archaeological excavation program in that country. Power had made skin/skeletons of his red-wing specimens at Kansas, and continued this technique in Toronto in an effort to maximize informational content of sacrificed birds. Such skins, lacking one wing, one foot and the beak which are, with the nearly complete skeleton, preserved separately, henceforth became known in the ROM as "Power skins," and remain the Department's preferred method of preparation.

Power helped interested ROM staff on statistical matters and taught biological statistics in Zoology, where he was cross-appointed as Assistant Professor. At the ROM, he studied morphometrics of the introduced House Finch (*Carpodacus mexicanus*) in eastern North America, wood warbler (Parulinae) foraging niches, and character variation in vireos (Barlow and Power 1970). He also guided the M.Sc. work of Phil Stepney at UT on range expansion of Brewer's Blackbird (*Euphagus cyanocephalus*). Power left in 1972 to become Director of the Santa Barbara Natural History Museum in California.

New Zealand takes its turn—Allan Baker (1943–).—A young New Zealander, Allan John Baker, was brought to Ornithology's attention by Johnston and Power because of strengths in multivariate techniques and evolutionary biology. Baker was hired as an Assistant Curator sight-unseen a short time after Power's departure.

Allan had been a student of John Warham's at the University of Canterbury in Christchurch, New Zealand, and brought with him expertise on the systematics and evolution of oystercatchers (Haematopodidae). In 1974, he was cross-appointed as Assistant Professor in Zoology, UT. He was to prove critical to the ultimate modernization of avian systematics in the Museum.

Technician numbers increase.—Several technicians in Ornithology, hired in the late 1960s and early 1970s, left for careers in zoology elsewhere. Included were Ross Harris, Lloyston Ferguson, and Mike McNall who, as well as working in skeleton and skin preparation, helped with fieldwork in British Columbia, Illinois, Jamaica, Montserrat, and Ontario.

Lloyston Ferguson (1935–), who worked on the then new vertebrate palaeontology gallery, was hired in Ornithology in 1970. He remained in the Department until 1989 before moving to Mammalogy. He was one of the several key figures, along with Glenn Murphy, Harris, McNall, Bruce MacRobie, and later Brad Millen, critical to rapid growth of the skeleton collection. Having four technicians devoting much of their lab time to preparation in the 1970s and early 1980s led to skeletal holdings of 30,000+ by 1983. Most of the technicians in Ornithology in 1974 are shown in Fig. 5.

Additional Research Associates.—In 1969 James D. Rising (1942–), an evolutionary biologist, was hired by Zoology, UT. He had just completed

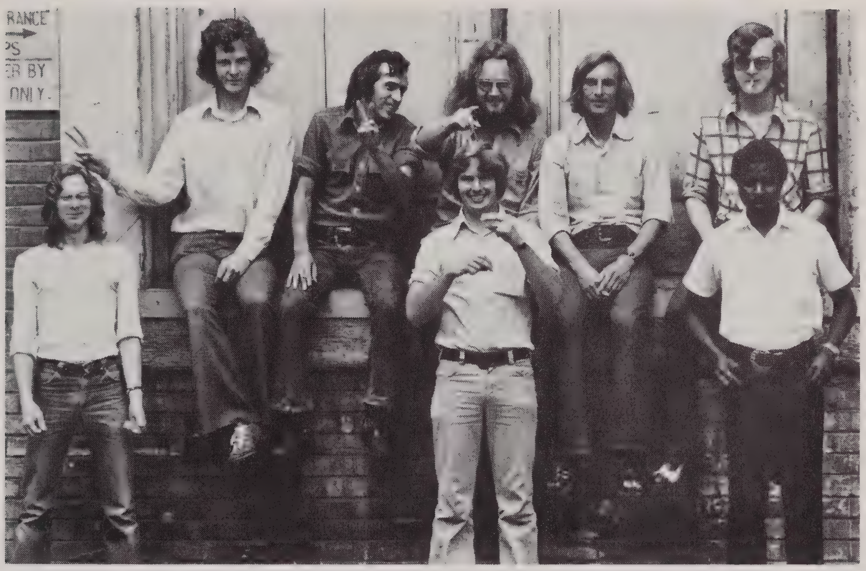

Fig. 5. Ornithology (o) and Mammalogy (m) Technicians at rest in 1974. From left to right. Top row: Michael Cadman (o), Glenn B. Murphy (o), Allan A. Outram (m), James Borack (m), Bradley G. Millen (o). Bottom row: Ross Jackson (m), Michael McNall (o), Lloyston Ferguson (o).

post-doctoral studies at Cornell with Jack Hudson, following doctoral work with Richard Johnston at Kansas on hybridization in Northern Orioles (*Icterus galbula* ssp.). He became a Research Associate in Ornithology in November 1969. His research interests in size variation in Savannah Sparrows (*Passerculus savanarum*) and similar specimen-based studies have resulted in the addition of more than 7000 skins and skeletons to the ROM's collections. At present, he is a Professor in Zoology, UT.

In the early 1970s Roger Hansell (1937–), an evolutionary theoretician and systematist, and long-term birder was appointed Research Associate in Ornithology. He is Professor in Zoology, UT. Many members of staff, including Research Associates, and most of the graduate students of the early 1970s are shown in Fig. 6.

Allan Baker assumes the Headship.—Allan Baker became Department Head in 1976 while still Assistant Curator, taking over from Barlow, who had served for 10.5 years. Baker was also on the ROM's senior management team in 1976–77 as Coordinator of Curatorial Service Departments. He was promoted to Associate Curator in 1976, Curator in 1981 and to Professor in Zoology (UT) in 1989.

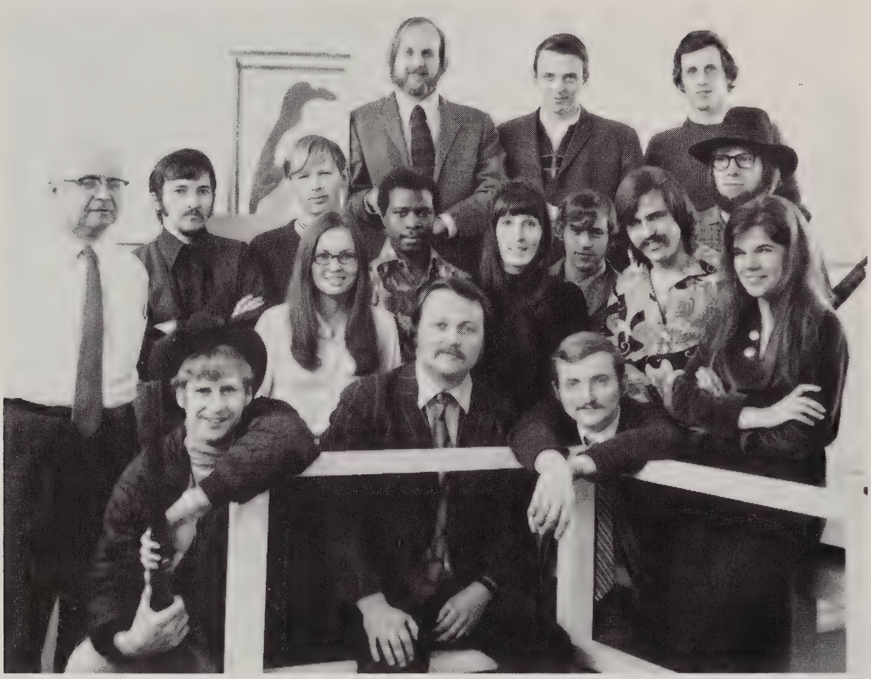

Fig. 6. A gathering of the clan: Ornithology Department staff and graduate students in 1971. Top row: Great Auk, Dennis M. Power, Gerald F. Shields (grad student), Peter L. McLaren (grad student). Third row: Howard G. Savage, Phillip H. R. Stepney (grad student), Robert M. Alison (grad student), Lloyston Ferguson, Glenn B. Murphy, Ross D. James. Second row: Veronika Klempt (research assistant), Donna M. Bunston, Jake C. Rice (grad student), Carol Goodwin. Front row: James A. Dick, Jon C. Barlow, James D. Rising.

His tenure in Ornithology has been marked by the introduction of computer-based cataloguing, upgrading of the Department's specimen preparation lab and the addition of an inhouse avian molecular genetics lab. He has overseen ventures in Argentina, South Africa, Iceland, Australia, New Zealand, India, Morocco, the Canaries, the Azores, Figi, the Netherlands, the Galapagos, Madeira and Denmark.

Steve Nash from Quebec—Steve Nash from Quebec was a technician from 1980–83. He assisted in studies of vireos in the Caribbean and west Texas, and Eurasian Tree Sparrows (*Passer montanus*) in Illinois with Barlow, and did fieldwork in Hawaii and Australia for Baker and in poorly-known northern Ontario with Ross James.

George (1921–) and Mark Peck (1960–).—George K. Peck, a veterinarian and nature photographer, was appointed Research Associate in 1977 after a long stewardship with the Ontario Nest Record Scheme. He continues in that capacity, visiting the ROM weekly from his retirement home in Midland, Ontario, to oversee nest-record scheme business. He became an Elective Member of the AOU in 1991.

Peck's son, Mark K. Peck, also a photographer and a graduate of the University of Western Ontario, London, was hired in early 1984 as a replacement for Steve Nash. The younger Peck, who had occasional field adventures with ROM bird staff as early as 1981, became a preparator, an operative in the genetics labs, and a tireless field worker. An observer of bird behavior and ecology, as well as a procurer of specimens for evolutionary and ecological studies of Baker, Barlow and James, his fieldwork has taken him to the Caribbean, Central America, across Canada, the U.S., Australia, New Zealand, Africa, Iceland, the Azores, and western Europe.

Oliver Haddrath.—In 1989, when Lloyston Ferguson moved to ROM Mammalogy, Oliver Haddrath shifted from halftime to full time in Ornithology. Haddrath's part-time status in Ornithology began in 1988 when he came to the ROM from an undergraduate specialist program in molecular genetics at UT, with skills in biochemical techniques important to Baker's program in avian genetics. Now specializing in molecular genetic assay, he has made major contributions to PCR and mtDNA studies undertaken by Baker and his students.

Departmental Assistants 1965–1992.—Prior to 1965, secretarial, departmental assistant responsibilities, and general management of the business affairs of the Department were handled extramurally by Museum administrative staff. Since 1965, 12 persons have held secretarial cum office manager responsibilities in the Department. At the time of Barlow's arrival, Susan Wilcox was doing both secretarial duties and assisting Jim Baillie with curatorial activities.

Margaret Goldsmith, who had an honors baccalaureate degree in life sciences from UT, enjoyed a nine-year career in Ornithology. In particular, she made major contributions to curatorial research and to local and foreign field research. Her tenure saw a major upgrading in all of the Department's business activities that she managed. Cathy Ayley, who arrived from the ROM's Membership and Development Department in 1992, most aptly replaced Margaret after her departure in late 1991, continuing the upgrading of our business affairs.

TOWARDS A MODERN ORNITHOLOGY 1965–1992

J. C. Barlow research.—The major post-1965 research in the Department began with Barlow's work on behavior and systematics of vireos, change in the introduced Eurasian Tree Sparrow population (Barlow 1973), and Ontario populations of Willow (*Empidonax traillii*) and Alder (*E. alnorum*) flycatchers, emphasizing their foraging and habitat differences (Barlow and McGillivray 1983). Subsequent investigation focused on genetic differentiation and species limits in meadowlarks (*Sturnella* spp.), in the Brewer's Sparrow (*Spizella* spp.) species complex, and on evolutionary genetics, behavior, and conservation biology of vireos in North America, the Caribbean and Neotropics (Barlow 1980, Barlow and Bortolotti 1988). Studies of vireos in the Chihuahuan Desert have received nearly 30 years of his attention.

Graduate students under Barlow's supervision often figured prominently in research programs of mutual interest, including studies of vireo behavior (Barlow and James 1975, Griffin 1986, Werden 1991), and evolutionary changes in morphometric, genetic (St. Louis and Barlow 1987, 1988, 1991) and cultural (vocal) (Lang and Barlow 1987) parameters in introduced Eurasian Tree Sparrows. The effects of environmental toxicity on breeding birds were of special interest to Ph.D. candidate Vincent St. Louis and Barlow between 1986 and 1991. St. Louis studied breeding success of Tree Swallows (*Tachycineta bicolor*) subjected to experimentally manipulated toxicity (St. Louis et al. 1990).

Taped vocalizations of the Vireonidae led to production with John William Hardy, University of Florida, of a double phonodisc (LP), and later an updated release on cassette, of the songs of that family (Barlow 1990). In another venture, vocalizations of the Mimidae were released similarly on cassette only (Hardy et al. 1987).

Ross James' research.—Ross James first studied foraging behavior and habitat selection in the Red-eyed (*Vireo olivaceus*), Warbling, and Yellow-throated (*V. flavifrons*) vireos for his M.Sc. work at UT (Table 1). His doctorate (Table 2) examined comparative behavior of Solitary (*V. solitarius* ssp.) and Yellow-throated vireos. He also became interested in vocalizations and specialized in studies of Solitary and Yellow-throated vireos (James 1978, 1981, 1984). In later years, he assessed the decline in passerine populations in Ontario. Fieldwork in central and northern parts of Ontario led to papers on species abundance in various habitats (James 1976, 1979). He collaborated with George Peck on a study of nesting of Ontario birds, using data from the Ontario Nest Record Scheme (Peck and James 1983, 1987). James also assessed effects of pesticides on breeding success of seasonal and permanent resident birds in managed forests, and he worked on the annotated checklist of Ontario birds (James et al. 1976, James 1991).

A. J. Baker's research.—Allan Baker was a recognized expert on oystercatchers when he arrived in Toronto (*Acridotheres* spp.) (Baker 1973, 1974, 1975, 1977), but in time shifted to evolutionary changes in introduced taxa, using protein electrophoresis to test implications of congruence between genetic and morphometric data in mynas (*Acridotheres* spp.) (Baker and Moeed 1987, Gibson et al. 1984), House Sparrows (Baker 1980), and European Starlings (*Sturnus vulgaris*) (Ross and Baker 1982). From the mid-1980s he focused on phylogeny, and genetic structuring in the Charadriiformes, especially shorebirds, using mtDNA and DNA amplification with PCR and DNA sequencing and other new molecular techniques.

With doctoral students Mike Dennison and Alejandro Lynch, Baker examined genetic, morphometric and cultural evolution in chaffinches (*Fringilla* spp.) in the Canary Islands and in *F. coelebs* in the Azores and Madeira (Baker et al. 1990, Dennison and Baker 1991). He also studied cultural change in song of native and introduced chaffinches from the Atlantic Islands and New Zealand (Baker and Jenkins 1987, Lynch et al. 1989, Lynch and Baker 1990). Other work included genetic differentiation among populations of Canada Geese (*Branta canadensis*) (Van Wagner and Baker, 1990). Molecular genetics, especially of Charadriiformes and chaffinches, remains the principal research focus.

PERSONS, PROGRAMS AND EVENTS OF HISTORIC SIGNIFICANCE

From the 1920s to the 1960s many young people received their first introduction to the study of birds from Snyder, Baillie, and Shortt, but no formal training of graduate students occurred as these men were not on the graduate faculty at UT.

Graduate education.—Barlow's appointment to both undergraduate and graduate faculties (UT) signalled the beginning of formal training of students in the ROM. Dennis Power supervised graduate students in ornithology, and Ross James served on Ph.D. supervisory committees in both Zoology and Forestry. Barlow and Baker, as cross-appointees to the Faculty of Arts and Sciences in Zoology at UT, have guided both masters and doctoral candidates in Zoology most of whom studied birds (Tables 1, 2).

TABLE 1. M.Sc. Students from Zoology, University of Toronto supervised by A. J. Baker and J. C. Barlow.

Student Name	*Completion Date*	*Topic*
Alison, Robert M.	1970	The behavior of the Oldsquaw (*Clangula hyemalis* Linnaeus) (Aves: Anatidae) in winter.[1*]
Bondrup-Nielsen, Soren	1974	Vocalizations, nesting and habitat preferences of the Boreal Owl (*Aegolius funereus*) in North America.[1]
Cadman, Michael	1980	Age-related foraging efficiency in the American Oystercatcher.[2]
Dick, James A.	1970	Geographic variation of the House Sparrow in Ontario.[1]
Griffin, Brete G.	1986	Habitat correlates of foraging behavior at two levels of temporal resolution in the Gray Vireo (*Vireo vicinior*).[1]
James, Ross D.	1968	Comparative foraging behavior and habitat selection of three species of *Vireo* (Aves: Vireonidae) in southern Ontario.[1]
McLaren, Peter L.	1972	An analysis of morphological variation in the Starling, *Sturnus vulgaris* L. (Aves: Sturnidae) in North America.[1]
Orenstein, Ronald I.	1970	Variation in the jaw musculature of members of the avian family Vireonidae.[1]
Palmateer, Calvor	1986	Assessment of vertebrate collections in small museums in Ontario.[1]
Pernanen, Satu K.	1994	Behavioral and ecological interactions of Brewer's (*Spizella breweri*) and Clay-colored (*S. pallida*) sparrows.[1]
St. Louis, Vincent L.	1986	Genetic and morphometric microevolution among introduced and ancestral populations of the Eurasian Tree Sparrow (*Passer montanus*).[1]
Skeel, Margaret I.	1976	Nesting strategies and other aspects of the breeding biology of the Whimbrel (*Numenius phaeopus*) at Churchill, Manitoba.[1]
Thompson, Peter A.	1983	A comparison of the North American and European populations of *Passer montanus* with considerations of some factors affecting their morphology.[1]
Phillips-Vazquez, Manuel	1992	Population divergence of ancestral and descendent populations of House Finches in North America.[2]
Werden, Allen H.	1990	Implications of geographic and interseasonal variation in the song of the Gray Vireo (*Vireo vicinior*).[1]

*Supervisor (University of Toronto): [1] J. C. Barlow, Zoology; [2] A. J. Baker, Zoology.

TABLE 2. Ph.D. Students from Zoology, University of Toronto either supervised by A. J. Baker or J. C. Barlow or other professors, but receiving guidance from Baker or Barlow as well.

Student Name	*Completion Date*	*Topic*
Alison, Robert M.	1972	The breeding biology of the Oldsquaw (*Clangula hyemalis* Linnaeus) at Churchill, Manitoba.[1]*
Bortolotti, Gary R.	1984	Evolution of growth rate and nestling sex ratio in Bald Eagles (*Haliaeetus leucocephalus*).[1]
Cosens, Susan E.	1984	Sources of selection on avian songs and singing behavior in marsh and grassland habitats.[2]
Dennison, Michael	1991	Morphometric and ecological differentiation of Atlantic island chaffinch (*Fringilla* spp.) populations.[3]
Featherstone, J. D.	1975	Aspects of nest site selection in three species of ducks.[2]
Fetterolf, Peter F.	1981	Agonistic behavior of Ring-billed Gulls during the post-hatching period.[4]
Gotfryd, Arnie	1985	Habitat determinants of breeding birds in urban woodlots.[5]
Harcus, John L.	1973	A study of song and territory in the catbird (*Dumetella carolinensis*).[2]
Holroyd, Geoffrey	1983	Foraging strategies and food of a swallow guild.[6]
Horn, A. G.	1987	Repertoires and song switching in Western Meadowlarks.[2]
Howes-Jones, Daryl	1982	The structure of an avian vocal communication system.[1]
Hughes-Murray, Janice	**	Social parasitism and evolution and systematics of the Neomorphinae (Cuculidae, Aves) with special reference to the Greater Roadrunner (*Geococcyx californianus*).[1]
James, Ross D.	1973	Ethological and ecological relationships of the Yellow-throated and Solitary vireos (Aves: Vireonidae) in Ontario.[1]
Jones, James	1987	Use of space by male White-throated Sparrows (*Zonotrichia albicollis*).[2]
Kopachena, Jeffrey	1991	Behavioral polymorphism in White-throated Sparrows.[2]
Kozlovic, Daniel R.	**	Factors affecting reproductive success of House Finches (*Carpodacus mexicanus*).[1]
Lang, Anthony J.	1994	Cultural evolution in the introduced North American population of the Eurasian Tree Sparrow.[1]

TABLE 2. (Continued) Ph.D. Students from Zoology, University of Toronto either supervised by A. J. Baker or J. C. Barlow or other professors, with many receiving guidance from Baker or Barlow as well.

Student Name	*Completion Date*	*Topic*
Lowther, James K.	1962	Color and behavoral polymorphism in the White-throated Sparrow, *Zonotrichia albicollis* (Gmelin).[2]
Lynch, Alejandro	1992	Cultural evolution in chaffinch song: a population memetics approach.[3]
Marshall, Dawn	**	Colonization routes and relationships of Atlantic island chaffinches deduced with asymmetric PCR and sequencing of mitochondrial DNA.[3]
McLaren, Peter L.	1975	Habitat selection and resource utilization in four species of wood warblers (Aves: Parulidae).[1]
Melemis, Steven	1980	Numerical methods for stochastic processes and contributions to the theories of territoriality and life history strategy.[2]
Nol, Erica	1984	Reproductive strategies in the oystercatchers (Aves: Haematopodidae).[3]
Ostroff, Shirley J.	1986	A phenetic study of the wood warblers (Parulinae).[1]
Rees, William	1973	Comparative ecology of three sympatric sparrows of the genus *Zonotrichia.*[2]
Rice, Jake C.	1974	Social and competitive interactions between two species of vireos (Aves: Vireonidae).[1]
Rola-Pleszczynski, Katrina W.	1977	Polygyny in the Lark Bunting.[7]
St. Louis, Vincent L.	1992	Effects of experimental acidification on the reproductive success of Tree Swallows.[1]
Shields Gerald F.	1974	A cytogenetic and DNA-DNA hybridization study of the genus *Junco* (Aves).[7]
Snell, Richard R.	1989	Morphometric and genetic affinities of Icelandic gulls: comparative analysis of a secondary contact zone between *Larus argentatus* and *Larus hyperboreus.*[7,3]
Stefanski, Raymond B.	1969	A study of distress calls of Song, Swamp and White-throated sparrows.[2]
Stepney, Phillip H.R.	1979	Competitive and ecological overlap between Brewer's Blackbird and the Common Grackle, with consideration of associated foraging species.[1]
Szijj, Laslo J.	1963	A comparative study of the sympatric species of meadowlarks (genus: *Sturnella*) in Ontario.[2]

TABLE 2. (Continued) Ph.D. Students from Zoology, University of Toronto either supervised by A. J. Baker or J. C. Barlow or other professors, with many receiving guidance from Baker or Barlow as well.

Student Name	*Completion Date*	*Topic*
Thorneycroft, H. B.	1986	A cytogenetic study of White-throated Sparrows, *Zonotrichia albicollis* (Gmelin).[2,8]
Van Wagner, Carol	1987	Genetic and morphometric evolution in Canada Geese (*Branta canadensis*).[3]
Wenink, Paul	1994	Molecular population structure in the Dunlin and turnstone: Inferences from mitochondrial DNA sequences.[3]
Zach, Reto	1976	Foraging behavior of the Ovenbird (Aves: Parulidae) in a patchy environment.[2]

*Supervisors (University of Toronto): [1]J. C. Barlow, Zoology; [2]J. B. Falls, Zoology; [3]A. J. Baker, Zoology; [4]D. Dunham, Zoology; [5]R. I. C. Hansell, Zoology; [6]F. G. Sprules, Biology (Scarborough Campus); [7]J. D. Rising, Zoology; [8]K. H. Rothfells, Zoology.

** Current Ph.D. students

University courses.—Baker and Barlow taught both undergraduate and graduate level courses at UT. Barlow's Systematic Ornithology (Zoology 467/1020, a two-semester course) was given for 27 years (1966–1993) to a total of nearly 150 students, before being replaced in 1993–1994 with two semester courses—Avian Biology (Zoology 386) and Bird Diversity (Zoology 387). Barlow has also taught in the Museum Studies Program, UT, twice serving as its Director (1989–1992 and 1993–1995). For more than 10 years, J. D. Rising has given a 3-week undergraduate field course on birds at sites in Canada, the U.S., and Costa Rica. Baker's graduate course in biostatistics (Zoology) has become standard fare for students of systematics and quantitative methodology.

Post-doctoral students.—Between 1978 and 1994, Allan Baker worked with five NSERC post-doctoral fellows on problems in avian genetics and morphometrics. In the same period, Barlow guided one postdoctoral worker on comparative myology of passerines.

Funding of research.—Research funds for Baker and Barlow came primarily from NSERC, the Canadian Wildlife Service (CWS), Ontario Renewable Resources Research Grants, Atlantic and Mississippi Flyway Councils, the Wildlife Toxicity Fund of the World Wildlife Fund, U.S. National Park Service, and Zoological Society of Metropolitan Toronto. Ross James received monies from the Canadian National Sportsmen's Fund and the Pesticides Advisory Committee, and Jim Dick from Ducks Unlimited Canada. Amounts of individual grants varied from $1000 to $100,000, with the bulk attributable to Baker, and totaled more than 1.3 million dollars (Can.) between 1965 and 1993.

Professional service.—Baker organized or co-organized symposia on evolutionary genetics of birds at the 19th (1986), 20th (1990), and the 21st (1994) International Ornithological Congresses (IOCs), and is widely consulted outside the ROM on matters of evolutionary genetics and avian cultural change.

Barlow's professional service included a vice-chairmanship of the Board of Management of the Metro Toronto Zoo (1994–1995); member of the Executive Committee of the Board of Directors of the Zoological Society of Metropolitan Toronto (1984–1992); President (1989–1991), Society of Canadian Ornithologists (SCO); Editor, Wilson Bulletin (1979–1984) and President of the Wilson Ornithological Society (1989–1991); Board of Directors of the Cooper Ornithological Society (COS) (1981–84), and COS Vice-president (1983–1985); Chairman (1984–1994) Board of Scientists of the Chihuahuan Desert Research Institute, Sul Ross State University, Alpine, Texas. For the XIX IOC Program

Committee (Ottawa, Canada, 1986), he chaired the Subcommittee on Contributed Papers. He also Chaired the Local Committee on Arrangements for the 84th AOU meeting at the ROM in 1967.

Ross James served as Chairman, Ornithology Subsection of the Committee on the Status of Endangered Wildlife in Canada; Chair, Technical Advisory Committee on Ontario Rare Breeding Bird Monitoring Program; Councilor of the SCO (1990–1992) and editor of its newsletter; and Board of Directors of the Long Point Bird Observatory (Ontario) (1991–).

Jim Dick taught an Adult Continuing Education course on Ontario birds through the ROM for three years (1986–1988). He served as judge of submissions to the decorative decoy competition at the Canadian National Sportsmen's Show for five years between 1981–1987, and at the Canadian National Exhibition in 1985, 1987, and 1989, and of taxidermy at the Toronto-based Hunting Show 1982–1984.

Scientific editorships.—Beside the Wilson Bulletin, Barlow also co-edited two volumes of Chihuahuan Desert research symposia proceedings (Barlow et al. 1986, Powell et al. 1990), and served on the editorial board of the XIX IOC from 1984–1988 (Ouellet 1988).

Allan Baker was on the International Board of Editors, University of Amsterdam Publications in Zoology in 1978. Ross James was involved in several editorial positions with Ontario Breeding Bird Atlas project from 1981 to 1987; from 1981–1987, he was Associate Editor of the Ontario Field Biologist, and editor of the Society of Canadian Ornithologists' newsletter. Baker (1975–1977), Barlow (1973–1976; 1983–1986) and James (1978–1980; 1992–1994) all served on the ROM's Life Sciences Editorial Board as Editor.

Honors and Awards.—Recognition for contributions to ornithology and museums were received by current curatorial staff as follows: Baker—AOU Fellow, 1988; Barlow—AOU Fellow, 1976, Fellow of the American Association for the Advancement of Science, 1981, elected a member of the International Ornithological Committee of the IOC at the XX meeting of the IOC, Christchurch, New Zealand, 1990; James—AOU Elective Member, 1985; George Peck—AOU Elective Member, 1991; and Rising—AOU Fellow, 1987. Barlow received an Award of Merit for Outstanding Service to the Ontario museum community from the Ontario Museum Association in 1993. George Peck and Ross James were given the Federation of Ontario Naturalists Certificate of Achievement for work and publications aiding conservation of Ontario birds. Jim Dick received numerous major awards for wood carvings of birds between 1989–1994.

FACILITIES AND COLLECTIONS: A CONTEMPORARY UPDATE

Electronic data storage and retrieval.—In the early 1970s Allan Baker obtained a federal grant in support of Ornithology's need to reorganize the collections, check specimen records, and enter catalog data into a Canadian national scheme. Funds for collections management were also obtained from the federal government in the 1980s and 1990s, for catalogers under what is now the Canadian Heritage Information Network (CHIN). Since 1984, technician Bradley Millen has had major responsibility for accessing and managing the specimen database and obtaining specimen data from all of Canada from CHIN (Fig. 7).

Research collections and aviary.—By 1992, the skin collection of both standard and Power preparations totaled 134,036 specimens. There were also 42,507 skeletons, ca. 12,000 sets of eggs and/or nests, 3890 specimens preserved whole in spirits, and 10,366 frozen tissue specimens.

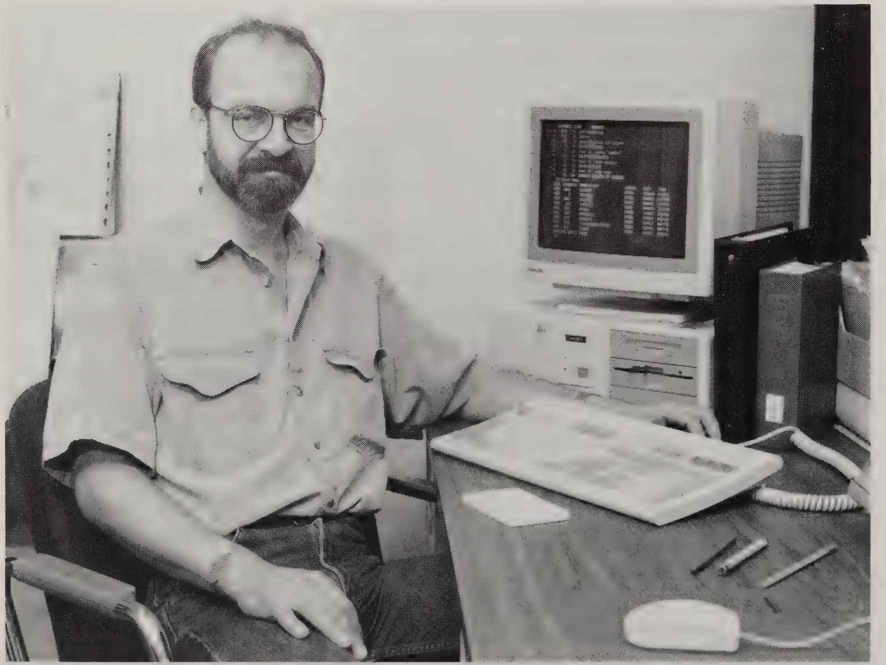

Fig. 7. Bradley Millen at the collection, cataloging desk in autumn 1992.

Ornithology (ROM) has long been among North American leaders in collection size in skins, skeleton and spirit specimens (Banks et al. 1973).

Sound lab.—Baker and Barlow have supervised several graduate students investigating avian vocalizations, who have made use of the large collection of vocalizations of vireos, *Passer montanus*, chaffinches, and oystercatchers, and total holdings from 1500 individuals of 150 species. A sound lab with Kay Elemetrics spectrographs existed in Bruce Falls' quarters in Zoology at UT before 1965. The sound lab, now in ornithology, contains a Dell computer housing Engineering Designs programs Signal and RTS, a Macintosh 840 Quadra with "Canary" (a Cornell University Laboratory of Ornithology song analysis system) and a Kay Elemetrics DSP Sona-Graph 5500, a real-time sound spectrograph system (Fig. 8).

Molecular systematics laboratory.—Ornithology, through Baker's efforts, has a molecular systematics laboratory, dedicated to molecular genetic assay of evolutionary relationships of birds. The lab contains all the basic equipment needed for cellulose acetate electrophoresis, restriction fragment length polymorphism for mtDNA assay, and sequencing of mtDNA with PCR (use of Polymerase Chain Reaction). The Laboratory of

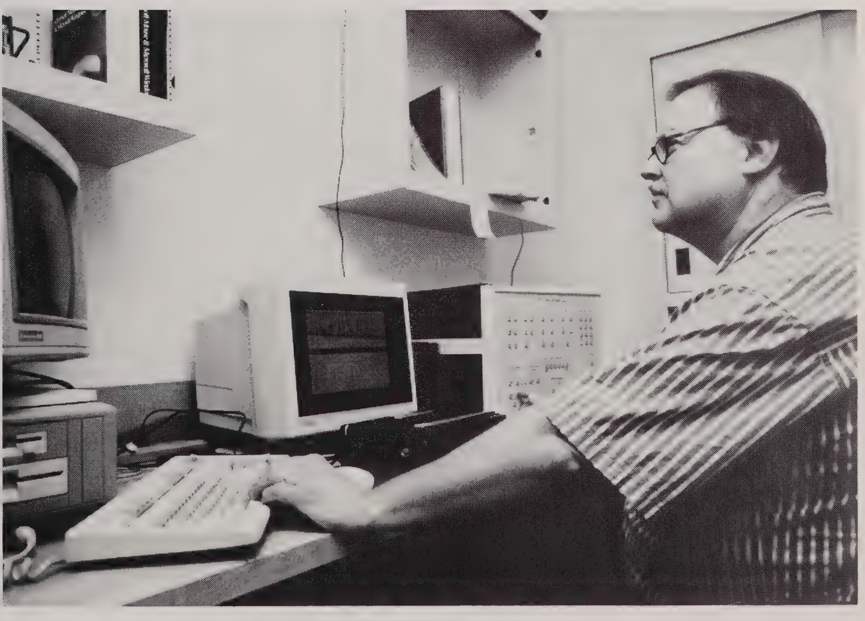

Fig. 8. Jon Barlow in the sound lab in Ornithology in June, 1992.

Analytical Systematics, a lab jointly funded by ROM Life Sciences and the Department of Zoology, UT, on the second floor of the ROM's Curatorial Center, houses starch gel and protein electrophoresis equipment and is regularly used by Ornithology.

Ontario Nest Records Scheme.—The provincial nest records scheme, in existence since 1936, is primarily a volunteer program sponsored by the Canadian Wildlife Service (CWS). It is one of six such schemes in Canada. Through 1993, of 292 species demonstrated or thought to breed in the Province, 280 are represented by one or more nest record cards with a total of more than 100,000 cards. All data are now electronically stored. The largest numbers of records at the end of 1993 were for the American Robin (*Turdus migratorius*), ca. 7000 cards, and Red-winged Blackbird, ca. 7500 cards (Peck 1994). Nesting data from the scheme from 1950 to the mid-1980s were published by Peck and James (1983, 1987).

Evolution and bird galleries.—Between 1981–82 Allan Baker, with Chris McGowan of the Department of Vertebrate Palaeontology, developed and executed an Evolution Gallery that addressed animal diversity and historical evidence for the evolutionary process (Fig. 9). The gallery used birds to illustrate hybridization (ducks), adaptive radiation (Darwin's finches: Geospizinae), plumage diversity with tanagers (Thraupinae), breeds of domestic pigeons (*Columba livia*) and elaborate courtship with birds of paradise (Paradisaeidae).

In 1965, the ROM's past history of exhibitry was still much in evidence in the galleries. Aging dioramas, and an unfocused mix of birds and mammal mounts, were the remnants of the once orderly exhibit program of the 1950s. Development of a permanent ornithology gallery started in 1988.

The Birds Gallery, covering 4600 sq. ft., demonstrates avian biodiversity and the negative effects of human actions on this diversity, and includes other interactive displays and a large diorama showing Long Point Marsh in late March with a wide variety of bird species. Phase 1, the bulk of the display, opened on 4 April 1990. Phase 2, an interactive birdsong work station featuring research on vocalizations, opened in March 1992.

Fig. 9. Allan Baker (right) and Chris McGowan (Vertebrate Palaeontology), choosing specimens that once flew, for the Evolution Gallery, 1981.

ACKNOWLEDGMENTS

Cathy Ayley nurtured several drafts of this manuscript and made many comments, always to the improvement of the text. My colleagues in the Ornithology Department (ROM), Allan Baker, Jim Dick, Oliver Haddrath, Ross James, Brad Millen, Glenn Murphy, Mark Peck, and Jim Rising provided insight, data, commentary, and jogged my memory at critical times. Allan Baker, Ross James, Brad Millen, Glenn Murphy, and Mark Peck loaned me photographs, and Julia Matthews, Head Librarian (ROM), made possible inclusion of the photo of J. H. Fleming. Bryan Boyle expertly produced the photos included in the text. Peter Buerschaper generously made available to me a copy of his biographical paper on the late Terry Shortt. Glen Wiggins provided details of the NRC grant that made possible the development of the Laboratory of Molecular Systematics.

For critical assistance in the field and my career, I thank and dedicate this account to the late Dr. W. E. Lockhart and Mrs. Lorabelle Lockhart of Alpine, Texas; all of my graduate students, my colleagues in ROM Ornithology and my extramural colleagues, Bill Hardy, Jerry Jackson, Richard Johnston, Bruce McGillivray, Ken Parkes, and Phil Stepney; my precious family—my wife Margaret May and my children Ella, Deron, Amy, Tim and Melinda Barlow, and Doug Brown, my son-in-law; my brother Tom and my late parents Dr. Charles C. Barlow and Margaret Isabel McCarty Barlow; and my parents-in-law, Janet May and John May.

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14

Alexander Wilson and the Founding of North American Ornithology

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ABSTRACT.—Alexander Wilson, born on 6 July 1766 in Paisley, Scotland, emigrated to America in 1794 and settled near Philadelphia. He taught school at Milestown until 1801 and then at Gray's Ferry where he met William Bartram who taught him what little was known about American birds. In 1802 Wilson decided to paint and describe North American birds. In 1806 he was hired by Samuel Bradford to edit Rees' *New Cyclopaedia* and convinced Bradford to publish the *American Ornithology*. Between 1806 and his death in 1813 Wilson visited four territories and 15 of the 18 states, and received specimens from the Lewis and Clark expedition. His nine-volume *American Ornithology* was the first taxonomic treatment of North American birds. In it Wilson described and pictured 268 of the 348 species that occurred in the United States east of the Mississippi, 26 species for the first time. In a dramatic departure from contemporary European ornithological works, Wilson stressed natural history. He performed the first breeding bird census and was the first to estimate populations from census data. He pioneered economic ornithology. His illustrations emphasized accuracy and his last plates demonstrated that accuracy was compatible with art. He was among the first to write of nature in terms of wonder and pleasure instead of awe and dread as was characteristic of earlier writers. The *American Ornithology* was the first major treatise on natural his-

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tory to be financed by subscription. Furthermore, the excellence of paper, typography, inks, and binding established the United States as Europe's equal in the manufacture of fine books. Wilson's influence on American ornithology was freely acknowledged by those who followed him, men such as Bonaparte, Audubon, and Baird. It is perpetuated through the activities of the Wilson Ornithological Society and Wilson's lasting contributions to ornithological taxonomy, but his important contributions to the development of naturalistic illustration and nature writing have been undeservedly forgotten.

Alexander Wilson (1766–1813), poet, peddler, pedagogue, weaver, and editor, was the first ornithologist to describe and illustrate American birds within the Linnaean taxonomic framework (Allen 1876, Welker 1955). Catesby (1731–1743) had approached birds scientifically and had written from first-hand knowledge, but his systematics were chaotic and his paintings inaccurate (Welker 1955). Bartram (1791) listed 215 species of birds, but provided no illustrations, and his taxonomy was unique. Wilson's application of Linnaean nomenclature to American birds represented a major scientific advance over his predecessors. His decision to include descriptions of behavior, distribution, ecology, migration, molt, and so forth in his species accounts represented an innovative, naturalistic, and quantitative approach to the study of birds. Previously published accounts of American birds by European systematists lacked such information or included inaccurate, second-hand accounts from travellers. In addition to his scientific contributions, Wilson introduced ecology and behavior into his illustrations (e.g., a Northern Oriole (*Icterus galbula*) about to grab a caterpillar from an overhanging leaf) and his approach to writing about birds marked a transition in our attitude toward nature from one of awe bordering on dread to one of quiet enjoyment (Welker 1955, Huth 1957, Egerton 1963). Finally, *American Ornithology* is the first major natural history publication that depended on a broad base of subscriptions for its financial success. This chapter expands on the importance of these generalizations.

Taxonomic and geographical coverage.—Wilson's American Ornithology was a pioneering achievement, unprecedented in its coverage of the avifauna of a single region and its use of colored plates to illustrate the description and biology of each species. European ornithologists wrote about birds of the world, but only about their taxonomy. Only Thomas Bewick, author of a *History of British Birds* (1797–1804), adopted a regional focus, but it was a modest book that broke no new ground.

Of an estimated 348 species found in the area covered by Alexander Wilson, he classified and described 255 species in eight volumes written between 1807 and 1813. Thirteen species were described by George Ord in a ninth volume based on Wilson's notes and paintings. Wilson included an additional 21 accounts, 12 of which detail sex (e.g., Common Yellowthroat, *Geothlypis trichas*), age (e.g., Red-tailed Hawk, *Buteo jamaicensis*), or seasonal (e.g., Blackpoll Warbler) variation in the plumage of species previously described. [Where scientific names are given in the tables they are not repeated in the text.] Two further accounts are of species described by earlier authors which Wilson concludes are age or plumage variants of species already described. Wilson concludes that the Sea Eagle (*Falco ossifragus*) is the immature Bald Eagle (*Haliaeetus leucocephalus*) and that the Ruddy Plover (*Charadrius rubidus*) is the summer plumage of the Sanderling Plover (*Charadrius calidris*) [now the Sanderling (*Calidris alba*)]. Wilson accepts separation by earlier authors of the Mottled (*Strix naevia*) and Red (*Strix asio*) owls, now considered plumage variants of the Eastern Screech-Owl *(Otus asio)*, and separation of the Dunlin (*Calidris alpina*) and the Purre (*Tringa cinclus*), now known to be the winter and juvenal plumages of the Dunlin. Finally, in five additional accounts Wilson mistakenly describes as new species females or males that differ from the sex he has already described. The mistakenly identified species and their probable correct identification (see footnotes to Table 1 for evidence supporting probable identification) are Autumnal Warbler (female, Bay-breasted [but see Table 1 for possible alternative]), Blue-green Warbler (female Cerulean Warbler), Pine-swamp Warbler (female Black-throated Blue Warbler [but see Table 1 for possible alternative]), Hemlock Warbler (female Blackburnian Warbler), and Slate-colored Hawk (male Sharp-shinned Hawk). Taken altogether Wilson wrote 276 accounts of North American birds in six years.

During these same six years Wilson spent approximately 19 months traveling the United States studying, collecting, and painting its birds, establishing a network of correspondents, and selling subscriptions to his *American Ornithology* (Cantwell 1961). He visited four territories and 15 of the 18 states. He became the first ornithologist to describe birds of western North America when he studied the specimens brought back by Lewis and Clark and deposited in the Peale Museum in Philadelphia.

Taxonomic importance.—By his own account Alexander Wilson first described 51 species of North American birds (Table 1). Of these, 20 species are credited to Wilson in the American Ornithologists' Union's (AOU) *Check-list of North American Birds* (1983). An additional five species (Table 2) whose first formal descriptions are now attributed to Wilson (AOU Check-list 1983) were attributed to others in *American Ornithology.* The earlier descriptions, however, preceded Linneaus (e.g., Catesby 1731), lacked Latin names (e.g., Latham 1781) or contained incom-

Table 1. Species Wilson claimed to have discovered listed taxonomically according to the AOU *Check-list of North American Birds* (1983). The publication date of Wilson's description is indicated along with the author and date of the first description, if different from Wilson. Original English and scientific names given by Wilson are listed along with those approved by the AOU *Check-list of North American Birds* (1983).

Common name (Wilson)	*Common name (AOU)*	*Scientific name (Wilson)*	*Scientific name (AOU)*	*Author and date of first description*
Yellow-throated Flycatcher	Yellow-throated Vireo	*Muscicapa sylvicola*	*Vireo flavifrons*	Wilson, Vol. I, Sep. 1808 Vieillot, Aug. 1808
Mourning Warbler	Mourning Warbler	*Sylvia philadelphia*	*Oporornis philadelphia*	Wilson, Vol. II, Jan. 1810
Red-cockaded Woodpecker	Red-cockaded Woodpecker	*Picus querulus*	*Picoides borealis*	Wilson, Vol. II, Jan. 1810 Vieillot, Aug. 1809
Song Sparrow	Song Sparrow	*Fringilla melodia*	*Melospiza melodia*	Wilson, Vol. II, Jan. 1810
Pine Finch	Pine Siskin	*Fringilla pinus*	*Carduelis pinus*	Wilson, Vol. II, Jan. 1810
Cerulean Warbler	Cerulean Warbler	*Sylvia cerulea*	*Dendroica cerulea*	Wilson, Vol. II, Jan. 1810
Solitary Flycatcher	Solitary Vireo	*Muscicapa solitaria*	*Vireo solitarius*	Wilson, Vol. II, Jan. 1810
Louisiana Tanager	Western Tanager	*Tanagra ludoviciana*	*Piranga ludoviciana*	Wilson, Vol. III, Feb. 1811
Clark's Crow	Clark's Nutcracker	*Corvus columbianus*	*Nucifraga columbiana*	Wilson, Vol. III, Feb. 1811
Lewis's Woodpecker	Lewis' Woodpecker	*Picus torquatus*	*Melanerpes lewis*	Wilson, Vol. III, Feb. 1811 Gray, 1849
Swamp Sparrow	Swamp Sparrow	*Fringilla palustris*	*Melospiza georgiana*	Wilson, Vol. III, Feb. 1811 Latham, 1790
Savannah Sparrow	Savannah Sparrow	*Fringilla savanna*	*Passerculus sandwichensis*	Wilson, Vol. III, Feb. 1811 Gmelin, 1789
Loggerhead Shrike	Loggerhead Shrike	*Lanius carolinensis*	*Lanius ludovicianus*	Wilson, Vol. III, Feb. 1811 Linnaeus, 1766
Black and Yellow Warbler	Magnolia Warbler	*Sylvia magnolia*	*Dendroica magnolia*	Wilson, Vol. III, Feb. 1811
Autumnal Warbler [a]		*Sylvia autumnalis*		Wilson, Vol. III, Feb. 1811
Waterthrush	Louisiana Waterthrush	*Turdus aquaticus*	*Seiurus motacilla*	Wilson, Vol. III, Feb. 1811 Vieillot, Oct. 1809

Table 1(continued). Species Wilson claimed to have discovered listed taxonomically according to the AOU *Check-list of North American Birds* (1983). The publication date of Wilson's description is indicated along with the author and date of the first description, if different from Wilson. Original English and scientific names given by Wilson are listed along with those approved by the AOU *Check-list of North American Birds* (1983).

Common name (Wilson)	*Common name (AOU)*	*Scientific name (Wilson)*	*Scientific name (AOU)*	*Author and date of first description*
Yellow-winged Sparrow[b]		*Fringilla passerina*		Wilson, Vol. III, Feb. 1811
Mississippi Kite	Mississippi Kite	*Falco misisippiensis*	*Ictinia mississippiensis*	Wilson, Vol. III, Feb. 1811
Tennessee Warbler	Tennessee Warbler	*Sylvia peregrina*	*Vermivora peregrina*	Wilson, Vol. III, Feb. 1811
Kentucky Warbler	Kentucky Warbler	*Sylvia formosa*	*Oporornis formosa*	Wilson, Vol. III, Feb. 1811
Prairie Warbler	Prairie Warbler	*Sylvia minuta*	*Dendroica discolor*	Wilson, Vol. III, Feb. 1811 Vieillot, Apr. 1809
Green Black-capt. Flycatcher	Wilson's Warbler	*Muscicapa pusilla*	*Wilsonia pusilla*	Wilson, Vol. III, Feb. 1811
Blue-green Warbler[c]		*Sylvia rara*		Wilson, Vol. III, Feb. 1811
Nashville Warbler	Nashville Warbler	*Sylvia ruficapilla*	*Vermivora ruficapilla*	Wilson, Vol. III, Feb. 1811
Black-billed Cuckoo	Black-billed Cuckoo	*Cuculus erythropthalmia*	*Coccyzus erythropthalmia*	Wilson, Vol. IV, Sep. 1811
American Crossbill	Red Crossbill	*Curvirostra americana*	*Loxia curvirostra*	Wilson, Vol. IV, Sep. 1811 Linnaeus, 1758
Sea-side Finch	Seaside Sparrow	*Fringilla maritima*	*Ammodramus maritimus*	Wilson, Vol. IV, Sep. 1811
Fish Crow	Fish Crow	*Corvus ossifragus*	*Corvus ossifragus*	Wilson, Vol. V, Feb. 1812
Green-blue or White-bellied Swallow	Tree Swallow	*Hirundo viridis*	*Tachycineta bicolor*	Wilson, Vol. V, Feb. 1812 Vieillot, May 1808
Connecticut Warbler	Connecticut Warbler	*Sylvia agilis*	*Oporornis agilis*	Wilson, Vol. V, Feb. 1812
Whip-poor-will	Whip-poor-will	*Caprimulgus vociferus*	*Caprimulgus vociferus*	Wilson, Vol. V, Feb. 1812
Warbling Flycatcher	Warbling Vireo	*Muscicapa melodia*	*Vireo gilvus*	Wilson, Vol. V, Feb. 1812 Vieillot, May 1808
Tawny Thrush	Veery	*Turdus mustelinus*	*Catharus fuscescens*	Wilson, Vol. V, Feb. 1812 Stephens, 1817
Pine-swamp Warbler[d]		*Sylvia pusilla*		Wilson, Vol. V, Feb. 1812

Table 1(continued). Species Wilson claimed to have discovered listed taxonomically according to the AOU *Check-list of North American Birds* (1983). The publication date of Wilson's description is indicated along with the author and date of the first description, if different from Wilson. Original English and scientific names given by Wilson are listed along with those approved by the AOU *Check-list of North American Birds* (1983).

Common name (Wilson)	*Common name (AOU)*	*Scientific name (Wilson)*	*Scientific name (AOU)*	*Author and date of first description*
Blue Mountain Warbler [e]		*Sylvia montana*		Wilson, Vol. V, Feb. 1812
Hemlock Warbler [f]		*Sylvia parus*		Wilson, Vol. V, Feb. 1812
Sharp-shinned Hawk	Sharp-shinned Hawk	*Falco velox*	*Accipiter striatus*	Wilson, Vol. V, Feb. 1812 Vieillot, Feb. 1808
Slate-colored Hawk [g]		*Falco pennsylvanicus*		Wilson, Vol. VI, Aug. 1812
Small-headed Flycatcher [h]		*Muscicapa minuta*		Wilson, Vol. VI, Aug. 1812
Broad-winged Hawk	Broad-winged Hawk	*Falco pennsylvanicus*	*Buteo platypterus*	Wilson, Vol. VI, Aug. 1812 Vieillot, 1823
Cape May Warbler	Cape May Warbler	*Sylvia maritima*	*Dendroica tigrina*	Wilson, Vol. VI, Aug. 1812 Gmelin, 1789
Red-breasted Sandpiper	Red Knot	*Tringa rufa*	*Calidris canutus*	Wilson, Vol. VI, Aug. 1812 Linnaeus, 1758
Solitary Sandpiper	Solitary Sandpiper	*Tringa solitaria*	*Tringa solitaria*	Wilson, Vol. VII, Apr. 1813
Bartram's Sandpiper	Upland Sandpiper	*Totanus bartramius*	*Bartramia longicauda*	Wilson, Vol. VII, Apr. 1813 Bechstein, 1812
Short-tailed Tern	Black Tern	*Sterna plumbea*	*Chlidonias niger*	Wilson, Vol. VII, Apr. 1813 Linnaeus, 1758
Great-white Heron	Great Egret	*Ardea egretta*	*Casmerodius albus*	Wilson, Vol. VII, Apr. 1813 Linnaeus, 1758
Semipalmated Sandpiper	Semipalmated Sandpiper	*Tringa semipalmata*	*Calidris pusilla*	Wilson, Vol. VII, Apr. 1813 Linnaeus, 1766
Ruddy Duck	Ruddy Duck	*Anas rubidus*	*Oxyura jamaicensis*	Wilson, Vol. VII, Apr. 1813 Gmelin, 1789

Table 1(continued). Species Wilson claimed to have discovered listed taxonomically according to the AOU *Check-list of North American Birds* (1983). The publication date of Wilson's description is indicated along with the author and date of the first description, if different from Wilson. Original English and scientific names given by Wilson are listed along with those approved by the AOU *Check-list of North American Birds* (1983).

Common name (Wilson)	*Common name (AOU)*	*Scientific name (Wilson)*	*Scientific name (AOU)*	*Author and date of first description*
Long-billed Curlew	Long-billed Curlew	*Numenius longirostris*	*Numenius americanus*	Wilson, Vol. VIII, Jan. 1814 Bechstein, 1812
Canvas-back Duck	Canvasback	*Anas valisineria*	*Aythya valisineria*	Wilson, Vol. VIII, Jan. 1814
Marsh Tern	Gull-billed Tern	*Sterna aranea*	*Sterna nilotica*	Wilson, Vol. VIII, Jan. 1814 Gmelin, 1789

[a] Wilson (1811) describes a warbler that is olive above, chin and breast dull yellow, white wing bars and tail-spots, dark legs, and yellow feet. The description suggested to Bent (1953) the Blackpoll Warbler (*Dendroica striata*) in fall plumage. However, Audubon's painting of the Autumnal Warbler (*Sylvia autumnalis* [20 August 1829]) is of two Bay-breasted Warblers (*Dendroica castanea*) in fall plumage. The latter seems more likely.

[b] Probably a Grasshopper Sparrow (*Ammodramus savannarum*) based on Wilson's (1811) description of the bird: a small sparrow with a striped crown, pale ochre breast, and short tail of pointed feathers; its habitat: fields of New York, New Jersey, and Pennsylvania; and its song: "short, weak, interrupted *cherup*, which it occasionally utters from the fences and tops of low bushes." Audubon's painting labelled "Yellow-winged Sparrow A.W., May 12, 1812," portrays a readily identifiable Grasshopper Sparrow.

[c] Wilson's (1811) only specimen was shot in early April, 1810 along the banks of the Cumberland River. He was unable to determine the sex, but his figure and description suggest a female Cerulean Warbler (*Dendroica cerulea*). The identification is strongly supported by Audubon's painting of a female Cerulean Warbler with the pencilled label "Blue-green Warbler, male, Sylvia rara, August 12th 1821."

[d] Bonaparte (cited by Brewer 1839) concludes that the heavy bill and bulky proportions evident in Wilson's illustration suggest a vireo. However, Audubon's painting of this species (11 August 1829) is of two female Black-throated Blue Warblers (*Dendroica caerulescens*). Audubon identifies the birds in a pencilled label as Pine Swamp Warbler, the name given by Wilson, and *Sylvia sphagnosa*, as proposed by Bonaparte in Brewer's (1839) revision of American Ornithology. Wilson's description of the white wing patch, pale ochre venter, white eye line, and "bluish reflections, particularly on the edges of the tail and on the head" support identification as a Black-throated Blue Warbler.

Table 1(continued). Species Wilson claimed to have discovered listed taxonomically according to the AOU *Check-list of North American Birds* (1983). The publication date of Wilson's description is indicated along with the author and date of the first description, if different from Wilson. Original English and scientific names given by Wilson are listed along with those approved by the AOU *Check-list of North American Birds* (1983).

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[e] Bonaparte (cited by Brewer 1839) concludes tentatively that this is a Cape May Warbler (*Dendroica tigrina*). Wilson's description of the a yellow-olive dorsum and yellow venter with dark streaks fits the Cape May Warbler as does his description of the song, ". . . a feeble screep, three or four times repeated," but his failure to mention the yellow rump is worrisome and his description of "the two exterior (tail) feathers, on each side, white on the inner vanes from the middle to the tips, and edged on the outer side with white, . . ." does not describe the Cape May Warbler's tail pattern (Blake 1966). Finally, Wilson states "This was a male. The female I have never seen," but his description is closest to a female Cape May Warbler. Audubon painted this species, but throws no light on its identity.

[f] Wilson's painting and descriptions of its behavior and anatomy strongly suggest a female Blackburnian Warbler (*Dendroica fusca*), despite his assertion that he painted a male. Audubon's painting labelled Hemlock Warbler, male, *Sylvia parus*, clearly portrays two female Blackburnian Warblers. Audubon's (1841) description of the nest fits well with Bent's (1953) description of the nest and nesting habitat of the Blackburnian Warbler.

[g] Brewer (1839) identifies this species as an adult, male Sharp-shinned Hawk. Wilson's earlier painting of a Sharp-shinned Hawk is of an immature female.

[h] The Small-headed Flycatcher (*Muscicapa minuta*) is known only from the paintings of Wilson and Audubon. Bonaparte (cited by Brewer 1839) initially referred the species to the genus *Sylvia* (Brewer 1839) and later to the genus *Wilsonia*. Ridgway (1885) changed the species name to *microcephala* and the Small-headed Warbler (*Wilsonia microcephala*) was listed as hypothetical by Chapman (1914).

Table 2. Species credited to other authors, now regarded as first described by Wilson (AOU Check-list 1983).

Original species and scientific names	*Wilson's species and scientific names*	*Current species and scientific names*	*Original source according to Wilson*	*Citation in American Ornithology*
House Wren [a] (*Motacilla domesticus* [*Regulus rufus*])	House Wren (*Sylvia domestica*)	House Wren (*Troglodytes aedon*)	Bartram 1791	Wilson, Vol. I, Sep. 1808
Marsh Wren (*Motacilla palustris* [*Regulus minor*])	Marsh Wren (*Certhia palustris*)	Marsh Wren (*Cistothorus palustris*)	Latham 1781 Bartram 1791	Wilson, Vol. II, Jan. 1810
Little Chocolate-breasted Titmouse (*Parus peregrinus*)	Bay-breasted Warbler (*Sylvia castanea*)	Bay-breasted Warbler (*Dendroica castanea*)	Bartram 1791	Wilson, Vol. II, Jan. 1810
Little Field Sparrow (*Passer agrestis*)	Field Sparrow (*Fringilla pusilla*)	Field Sparrow (*Spizella pusilla*)	Bartram 1791	Wilson, Vol. II, Jan. 1810
Le Soulciet	Tree Sparrow (*Fringilla arborea*)	American Tree Sparrow (*Spizella arborea*)	Buffon 1770	Wilson, Vol. II, Jan. 1810
Pine Creeper	Pine-creeping Warbler (*Sylvia pinus*)	Pine Warbler (*Dendroica pinus*)	Catesby 1731	Wilson, Vol. III, Feb. 1811

[a] Vieillot is considered the author of this species by the AOU Checklist (1983) based on his description of the House Wren published in May of 1809 (Browning and Monroe 1991). However, Wilson described the House Wren in Volume I of *American Ornithology*, published in September 1808.

plete physical descriptions. A sixth species, the House Wren (*Troglodytes aedon*, Table 2) described by Wilson, who credits Bartram (1791) with its discovery, is attributed to Vieillot (1808) in the AOU Checklist (1983). However, Wilson's description was published in September 1808 and Vieillot's in May 1809 (Browning and Monroe 1991), which means that Wilson's is the first complete description of the House Wren (*Troglodytes domestica*). Thus 26 species of North American birds were first named and described by Alexander Wilson.

What of the 31 species Wilson thought he was introducing, but which are attributed now to other authors? Nine species were described by authors probably unknown to Wilson. The names given by Wilson to three species had already been applied to other species. Twelve species were described by authors familiar to Wilson, but he failed to match their accounts with his specimens; the remaining seven descriptions are of birds that Wilson misidentified as new species.

Of the nine species described by authors unknown to Wilson, seven were first described by Vieillot (1807–1809) whose claim to priority of description varies from one month (Yellow-throated Vireo, Table 1) to four years (Tree Swallow and Sharp-shinned Hawk, Table 1). Two additional species, the Upland Sandpiper and Long-billed Curlew were described by Bechstein (1812), a few months to a year before Wilson described the same species. Neither Vieillot nor Bechstein is cited by Wilson. That Wilson was unaware of their work is not surprising given the close proximity of publication dates, the difficulty of trans-Atlantic communication during the Napoleonic wars, and the obscurity in which Vieillot worked (Oehser 1948).

Of the three species whose names had been applied previously to other species, one, *Picus torquatus*, the name Wilson gave to Lewis' Woodpecker, had been applied to a European woodpecker in an obscure, privately published paper by Boddaert (1783) whose work was probably unknown to Wilson.

In his description of the Tawny Thrush Wilson states (Brewer 1839:392):

> "Though I have given this bird the same name that Mr. Pennant has applied to one of our Thrushes, it must not be considered as the same; the bird which he has denominated the Tawny Thrush being evidently, from its size, markings, &c. the Wood Thrush, already described."

Although Wilson correctly described a new species of thrush distinct from the Tawny Thrush (*Turdus mustelinus*) of Pennant and Latham, the confusion of names caused by his use of the same name for a different species was corrected later by Stephens (1817) who is credited with naming the Veery, originally *Turdus fuscescens,* now *Catharus fuscescens.* Inexplicably Wilson gave the same Latin name, *Falco pennsylvanicus,* to both the Slate-colored Hawk (adult, male Sharp-shinned Hawk) and the Broad-winged Hawk. Although Ord corrected the mistake in 1824 (Faxon 1901), he was too late. A year earlier Vieillot's (1823) Latin designation, *Sparvius platypterus,* became the first unambiguous Latin name for the Broad-winged Hawk.

Six of the species Wilson claimed to be introducing had been described by Linneaus (1758, 1766), five by Gmelin (1789), and one by Latham (1790), all of whom Wilson cited frequently. For whatever reason he failed to match his specimens with their descriptions.

In five species plumage variation between sexes, ages, and seasons led Wilson to describe two species where only one existed (Table 1). Two additional species described by Wilson, the Blue-Mountain Warbler (*Sylvia montana*) and the Small-headed Flycatcher (*Muscicapa minuta*), have never been matched to currently recognized species. Audubon (1966) also painted both, but his paintings do not permit identification.

The duplicate names, the misidentified species, the failures to cite Linneaus, Gmelin, and Latham occur more frequently when the interval between volumes is short (Table 3), especially if considered as a proportion of new species described. Six species among the 24 (25%) Wilson believed to be new in the first three volumes are in error compared with 15 species among the 27 (56%) he believed to be new in the last five volumes (Table 3). The decreasing time devoted to preparation and the increased proportion of errors suggests that Wilson's preparation of later volumes was less thorough than that of earlier volumes. The decreasing thoroughness coincides with the increasing economic pressure to publish the later volumes rapidly, the increased work load as Wilson took on the duties of colorist in addition to those of author, illustrator, and salesman, and, in volumes 6, 7, and 8, Wilson's deteriorating health. By contrast, species that should have been attributed to Vieillot, Bechstein, and Boddaert are distributed fairly evenly across Wilson's volumes (Table 3), which supports the conclusion drawn above, that Wilson was unacquainted with these authors.

Time and economic pressures contributed to many of Wilson's taxonomic errors, but these errors affect substantially less than 10% of all species accounts and fewer accounts than the number of species introduced by Wilson and still attributed to him. Furthermore, Wilson's accomplishments need to be judged in the context of its time.

To put such judgment in quantitative terms we used the species listed in Sibley and Monroe (1990). We verified all citation dates and tabulated species by year of citation to produce a list of the number of currently valid species described per year from 1758 to the present. For graphical

Table 3. Distribution of citation errors among species Wilson claims to have first described.

	AMERICAN ORNITHOLOGY							
	Vol. I	*Vol. II*	*Vol. III*	*Vol. IV*	*Vol. V*	*Vol. VI*	*Vol. VII*	*Vol. VIII*
Months since publication of previous volume	20[a]	16	13	7	5	6	7	5
Number of species for which Wilson claims first description	1	6	17	3	10	5	6	3
Actual first description by Vieillot, Bechstein, or Boddaert	1	1	3	0	3	0	1	1
Actual first description by Linnaeus, Gmelin, Latham	0	0	4	1	0	2	4	1
Species misidentified or misnamed	0	0	2	0	4	3	0	0
% errors[b]	0	0	35	33	40	100	67	33

[a] The time during which Wilson worked on the first volume is estimated from January 1807, eight months after he accepted employment with Bradford and Inskeep as editor of Rees' *New Cyclopaedia.*

[b] Includes species described by Linnaeus, Gmelin, and Latham; birds misidentified as new species; and species given names previously assigned to other species.

presentation we reduced the large range of variation by taking the fourth root of the number of species described/year. The effect is similar to taking the logarithm (Tukey 1977), but handles zeroes without requiring adjustment of the raw numbers. The large dynamic range of the raw data—from 411 species in 1758, to 0 in 1759—made some transformation useful for seeing the structure in the data. The data were then plotted as species/year to the fourth root versus year. The curved line is fitted using the function lowess (Cleveland 1979, Chambers et al. 1983, Statistical Sciences, Inc. 1993). This is a robust, smoothing function, using local linear, weighted fits. A window, dependent on f—the fraction of values selected for use—is placed about each x value. Points that are inside the window are weighted so that nearby points get the most weight. We set $f = 1/10$.

Figure 1 shows an initial high point representing publication of the 10th edition of the *Systema Naturae* followed by wide variation from year to year, but an average (indicated by the smoothed curve in Fig. 1) that remains below 20 species/year before climbing in the early 1800s and reaching a peak of 100–150 species/year from 1830–1850 after which a gradual decline occurs as fewer and fewer species remain to be described. At the time Wilson published his *American Ornithology* (Fig. 1) taxonomic activity as measured by the number of species described per year was just beginning to increase after a period of relative inactivity. Indeed Wilson's 26 new species of birds account for 27% of the 96 North American species described during the years in which he published.

Wilson's taxonomic achievement is all the more remarkable when one considers that he worked without the financial and intellectual support available to European collectors and taxonomists of the time. Wilson appreciated and frequently acknowledged his intellectual debt to Charles Willson Peale, who, like Wilson, advocated Linnaean taxonomy and opposed Buffon's theory of degeneration of American forms; to Thomas Jefferson, also an opponent of Buffon's theory; and to William Bartram, America's foremost naturalist. Nonetheless, Wilson lacked the intellectual challenge of the scientific debates among Illiger, Temminck, Etienne Geoffroy Saint-Hilaire, Cuvier, and Latham. Wilson acknowledged his frequent use of the ornithological collection at the Peale Museum, but this resource could hardly compare with the museums of Berlin, London, Leiden, or Paris (fewer than 1000 specimens of birds and mammals in the Peale Museum [Stresemann 1975]).

Wilson's isolation was due in part to the state of war that existed between England and France and the resultant difficulty of communication across the Atlantic. If the species listed in Sibley and Monroe (1990) are assigned positive integers beginning with *Struthio camelus* (= 1) and ending with *Dolichonyx oryzivorus* (= 9672) and plotted on the x-axis versus

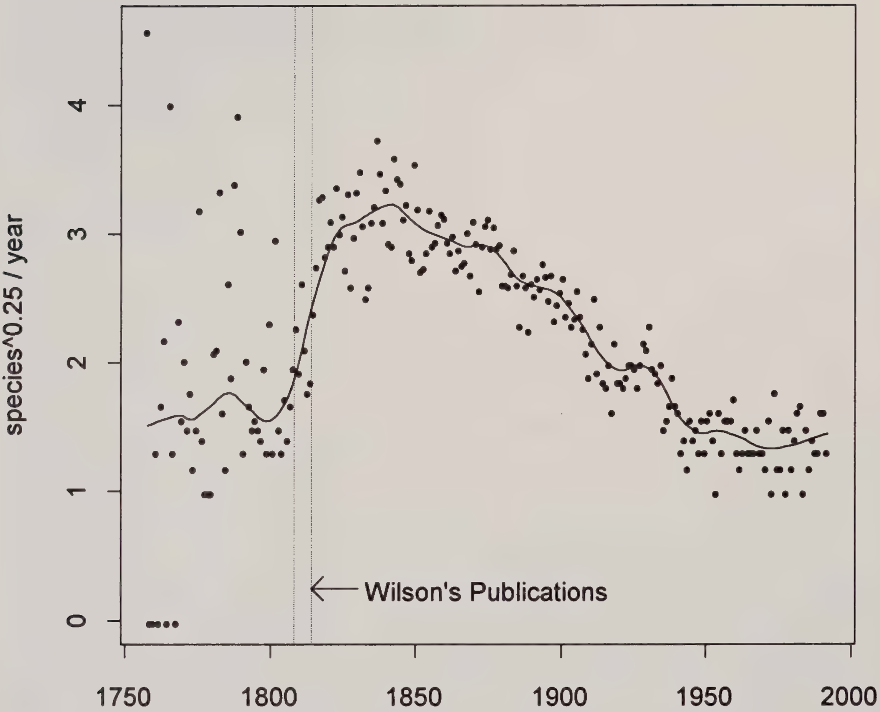

Fig. 1. Plot of the fourth root of the number of new species of birds of the world reported each year versus the year reported.

the citation date on the y-axis, the lull in publication of new species descriptions coinciding with the Napoleonic wars in the 1790s and early 1800s is evident as a horizontal gap in Figure 2. Wilson's ornithological activities were entirely confined to this period of taxonomic inactivity.

In the early 1800s the rules of ornithological taxonomy were poorly codified and the Family category was ill defined (Stringham 1958, Stresemann 1975). Without a clear taxonomic level between Order and Genus, Wilson expanded the boundaries of existing genera to encompass all North American species (Tables 1 and 2). However, his frustration with generic definitions is summarized in the following thoughtful comments from his account of the Blackpoll Warbler (Brewer 1839:287):

> "This bird may be considered as occupying an intermediate station between the Flycatchers and the Warblers, having the manners of the former, and the bill, partially, of the latter. The nice gradations by which nature passes from one species to another, even in this

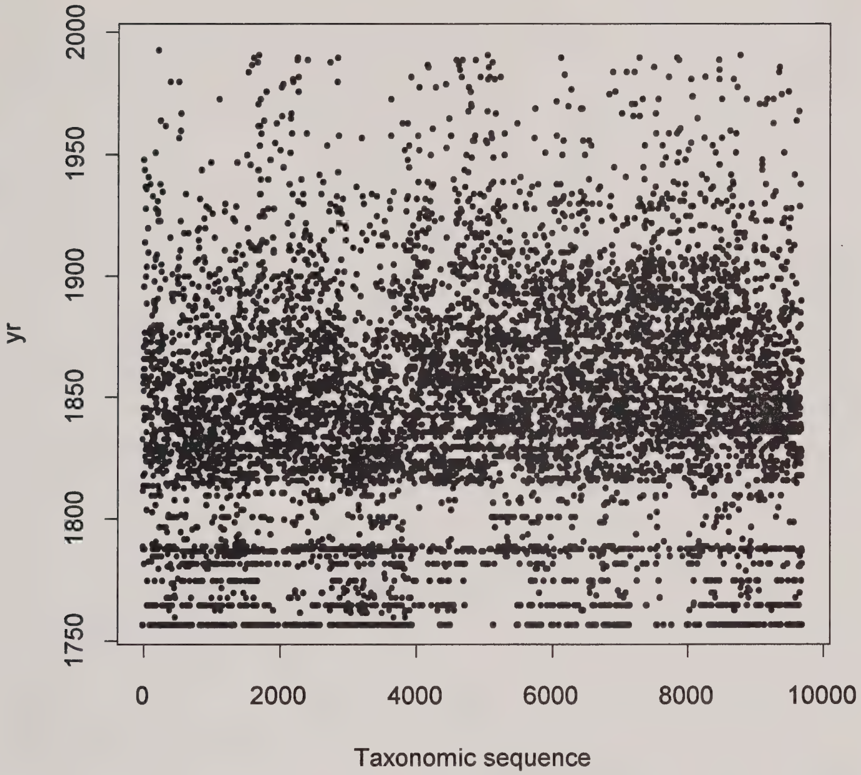

Fig. 2. Species of birds plotted by year of discovery. The lack of activity during the Napoleonic wars, from about 1790 to 1820, is evident as a light band of few points extending horizontally across the figure.

> department of the great chain of beings, will forever baffle all the artificial rules and systems of man. And this truth every fresh discovery must impress more forcibly on the mind of the observing naturalist."

Unsure as he often was as to generic placement of species, Wilson simply forced species into existing genera within the Linnaean system. The fourth root of the number of new genera erected/year versus year are plotted in Figure 3 using the same method as described for Figure 1. A quick examination of Figure 3 shows that few new genera were created until about 1810, that Wilson simply followed the practice of most taxonomists of his day and made new species fit existing genera. For example J. F. Gmelin's thirteenth edition of Linnaeus' *Systema Naturae* (1788–1789) introduced many new species, but not one new genus. Frustration with the

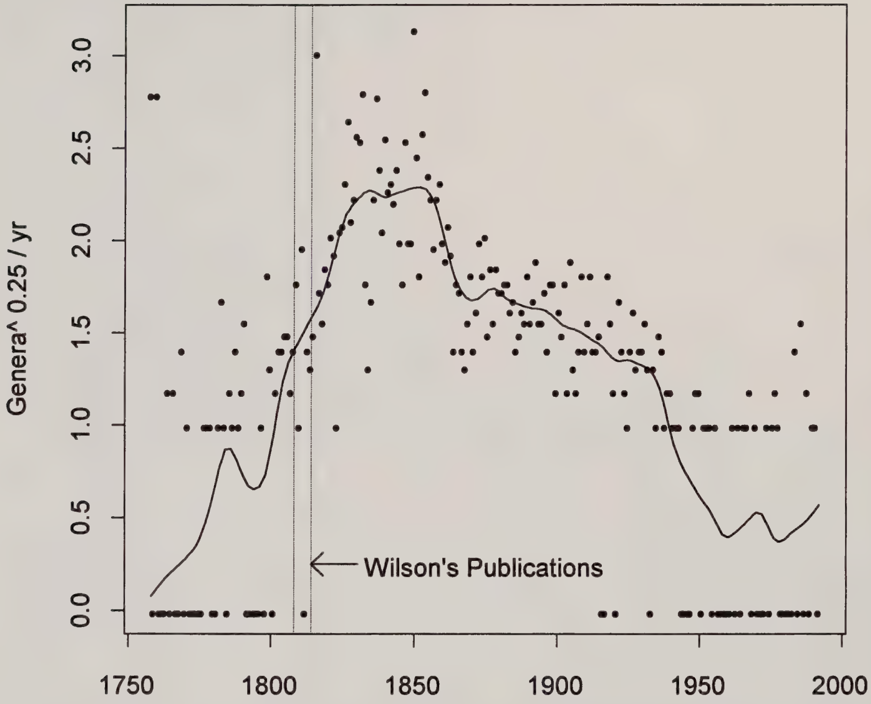

Fig. 3. Plot of the fourth root of the number of new genera of birds reported each year versus the year of publication.

growing artificiality of the Linnaean genera gave way in the early to mid 19th century to the introduction of many new genera (Fig. 3) and revision of many species and generic relationships. Better definition of the Family category also contributed to the resolution of some problematic relationships, but these changes occurred after Wilson's death. At the time Wilson wrote, taxonomists arranged species within Linneaus' generic divisions.

Coming during a period of minimal taxonomic discovery, Wilson's *American Ornithology* helped stimulate the subsequent surge of ornithological exploration. In addition, Wilson's own contributions to ornithological discovery are important (Fig. 4). Figure 4 depicts the number of species described by an author, as a function of worldwide activity during the same period. The plotted value is a ratio of the number of currently valid North American species described by an author divided by the number of species described worldwide by all authors publishing during the time that the author published his own species descriptions. The ratio was calculated only for authors contributing nine or more currently valid North

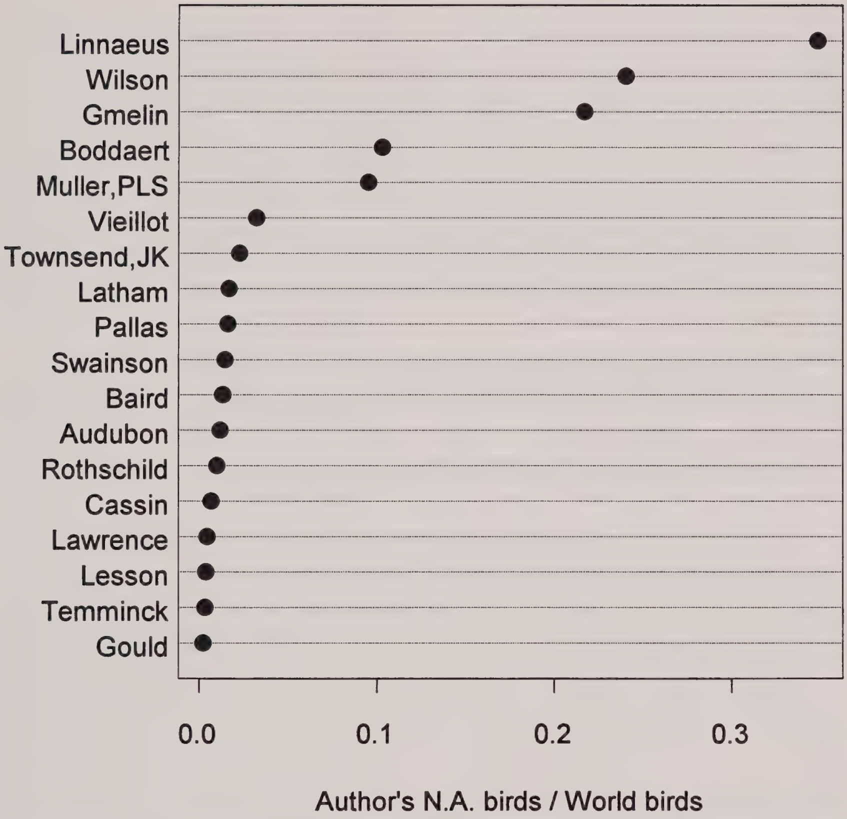

Fig. 4. The number of currently valid North American species described by an author divided by the number of species described worldwide by all authors publishing during the time that an author published his own species descriptions. Only authors describing nine or more North American species are included.

American species. Due to synonymy an author's period of publishing activity could extend beyond the period used in this analysis. Figure 4 clearly shows Wilson to have been a major contributor to the early description of North American birds.

Wilson's contributions to systematics cannot be summarized only by enumerating new species described. He corrected many errors found in earlier accounts. For example, earlier writers had mixed together the Northern (Baltimore) Oriole and Orchard Oriole (*Icterus spurius*), claiming no fewer than six species of orioles based on sex and age variations in plumage. Wilson was able to resolve the confusion through a detailed study of physical features, song, nest building and structure, color of the eggs, and by keeping birds through several molts to observe the progression of plumage changes. Similarly he resolved the confusion surrounding the Scarlet Tanager (*Piranga olivacea*) by raising and keeping live birds and showing that the four species previously identified were the two sexes and different plumages of the same species.

Despite Wilson's reluctance to create new genera he was not reluctant to reclassify species as indicated by his reclassification of the Blue Yellow-back Warbler (Northern Parula, *Parula americana*), which Linnaeus had classified as *Parus americanus.* Wilson offers the following rationale for placing the Northern Parula with the warblers (Brewer 1839:270):

> "Notwithstanding the respectability of the above authorities, I must continue to consider this bird as a species of Warbler. Its habits, indeed, partake something of the Titmouse; but the form of its bill is decidedly that of the *Sylvia* genus."

Importance to the development of ornithology in North America.—The importance of Wilson's American Ornithology goes far beyond its contributions to the taxonomy of North American birds. Wilson's species' accounts emphasize behavior, ecology, song, economic impact, and anatomy. They combine careful observation of specimens with careful field observation and thoughtful interpretation. The account of the Orchard Oriole is a good example of how Wilson relied on many aspects of the species' biology to resolve existing taxonomic confusion. Such emphasis on field biology was unusual among biologists of the early 19th century. Latham (1781) referred occasionally to field observations in his taxonomic accounts, but only Carl Illiger among the European systematists shared Wilson's emphasis on the importance of field biology to systematics (Stresemann 1975).

Furthermore, Wilson generated and tested ideas. For example, observation of the Mississippi Kite (*Ictinia mississippiensis*), which Wilson discovered, suggested to him that the kite fed on insects captured in the air. He confirmed his supposition by dissecting a kite and identifying its stomach contents, which included many insects. He also tested other people's ideas. Catesby (1731) noted, based on plumage, that only female Rice Birds (Bobolinks, *Dolichonyx oryzivorus*) migrated through South Carolina, which seemed odd to him. Bartram (1791) also found the phenomenon odd, but after dissecting birds captured in the fall he, like Catesby, found no males. Wilson not only dissected Bobolinks caught in the fall in South Carolina and like his predecessors was unable to sex them, but also kept a number of birds over winter and showed that in the spring some of them molted into male plumage thereby announcing their sex and solving a long standing question.

After his death, Wilson's notebooks were lost, but a recently published (Davis and LeCroy 1994) sketch of a Great Egret with marginal notes confirms that Wilson made detailed observations of dimensions, structures, and colors. This conclusion is supported by notes on color and pattern that are written on some of Wilson's sketches in the Museum of Comparative Zoology (MCZ) collection at Harvard University. The Great Egret notes do not exactly correspond with Wilson's published account of the Great Egret which suggests that he worked with data from more than one individual when writing his accounts.

Wilson introduced mathematics into his accounts, for example in the following conservative estimate of a flock of Passenger Pigeons (*Ectopistes migratorius*) (Brewer 1839:399):

> "If we suppose this column to have been one mile in breadth, (and I believe it to have been much more,) and that it moved at the rate of one mile in a minute, four hours, the time it continued passing, would make its whole length two hundred and forty miles. Again, supposing that each square yard of this moving body comprehended three Pigeons, the square yards in the whole space, multiplied by three, would give two thousand two hundred and thirty millions, two hundred and seventy-two thousand Pigeons!—an almost inconceivable multitude, and yet probably far below the actual amount."

His census of migratory birds breeding in Bartram's eight-acre garden (preface to Vol. 4, pp. 5–10, only in early editions, not reprinted in later editions [Burns 1907]) was the first breeding bird census, and his extrapolation from the sample to the population of migratory birds inhabiting Pennsylvania was the first estimate of a wildlife population (Elman 1982). He found 51 pairs of nesting, migratory birds and estimated that the 3,200,000 acres of suitable habitat in Pennsylvania would support at least 100,000,000 migratory birds.

Wilson's influence on future ornithologists was profound. In 1810, while in Louisville, he met Audubon (Ord 1828, Audubon 1831–1839). He lodged at the Indian Queen Tavern where the Audubon family lived, spent an afternoon hunting birds with Audubon, and undoubtedly discussed them with the 25-year-old naturalist-artist who looked through Wilson's first two volumes and showed Wilson his sketches. Despite the charges and countercharges with which Ord and Audubon have obscured this meeting, Wilson's visit probably inspired Audubon to undertake *The Birds of America* (Hunter 1983). While there can be no question of the artistic superiority of Audubon's paintings, Wilson's influence is not hard to find. Wilson's plates portray 316 individual birds, of which 39 are portrayed by Audubon in similar plumages and postures. The similarities vary from slight to almost identical. For example, Wilson's Downy Woodpecker (*Picoides pubescens*) clings to a trunk covered with a grid of Yellow-bellied Sapsucker (*Sphyrapicus varius*) holes as does Audubon's Downy Woodpecker, although its posture and association with the sapsucker holes are different. The Bald Eagles (*Haliaeetus leucocephalus*) of both men are standing on a rock with one foot on the rock and the other grasping a large fish, although the fish are of different species. The bodies of both eagles are horizontal with the wings slightly outspread. The heads of both are in profile with the bill slightly open. Wilson's eagle has its neck extended and tail down, Audubon's eagle has its neck withdrawn and tail horizontal, but the similarities are striking. Six portrayals by Audubon are identical (tracings can be superimposed) to Wilson's earlier paintings. The species portrayed include the Northern Flicker (*Colaptes auratus*), copied three times; Chestnut-sided Warbler (*Dendroica pensylvanica*); Mississippi Kite; Cerulean Warbler; Red-winged Blackbird (*Agelaius phoeniceus*), two different individuals copied; and Common Ground-Dove (*Columbina passerina*). The composition of Audubon's paintings is superior to Wilson's and his birds are better proportioned, more readily identifiable, and more alive, but the influence of Wilson's earlier work is undeniable. Wilson also influenced Audubon's collaborators, Mason who provided the habitats (Davidson 1966) for many of Audubon's plates provided the Downy Woodpeckers with the branch gridded by sapsucker holes thereby borrowing from Wilson's plate. Havel who engraved Audubon's plates needed a second Mississippi Kite to fill out the plate on this species and turned to Wilson's plate for his second bird. In addition Wilson had awakened the public's interest in the birds of North America and thereby helped to ensure the financial success of Audubon's *The Birds of America* (Hunter 1983).

Wilson's influence was not limited to Audubon and his collaborators. Thomas Nuttall published a handbook of North American birds (1834). The book is roughly pocket size and meant to be both portable and affordable. It remained a standard reference work throughout the 19th century. It cites Wilson frequently, but his influence is most noticeable in the black-and-white figures prepared by Messrs Andrews and Co. of Boston. Fewer than half of the species accounts are illustrated, but of the 61 illustrations, 15 are of species not mentioned by Wilson, 16 illustrations are unlike those found in Wilson's accounts, six illustrations are similar, and 24 are the same or mirror images of Wilson's illustrations.

Charles Lucien Bonaparte, ornithologist, systematist, and nephew to Napoleon, arrived in Philadelphia in 1823 at the age of 20. He was so impressed with Wilson's work that he undertook to complete it, abandoning his previous plan to prepare an *Ornitologia Romana* on the birds of his native Italy. In the summer of 1825 Bonaparte published the first volume of *American Ornithology: or, the Natural History of Birds Inhabiting the United States not given by Wilson.* Bonaparte's illustrator was Alexander Rider, formerly a colorist for Alexander Wilson. Volumes 2 and 3 were published in 1828 and volume 4 in 1833, by which time Bonaparte had returned to and settled in Rome. He went on to become one of the great systematists in ornithology and a leader of the taxonomic revolution of the 1830s and 40s (Stresemann 1975).

In the late 1830s at Dickinson College a young student by the name of Spencer Fullerton Baird opened the college's copy of Wilson's *American Ornithology* and promptly cut his classes to read all nine volumes (Kastner 1986). A few months later Baird saw Audubon's *The Birds of America.* Together these books directed his interest into ornithology. He was to become the first Assistant Secretary and second Secretary of the Smithsonian Institution where he was responsible not only for the ornithological exploration of North America, but also for making the Smithsonian into one of the finest museums and with one of the finest ornithological collections in the world. Like Wilson before him, Baird established a vast network of correspondents who provided him with specimens and information. In 1883, only a few years before he died, Baird helped found the American Ornithologists' Union.

Influence on nature writing.—While Wilson's American Ornithology profoundly influenced science, it also influenced the prevailing view of nature. Unlike the European taxonomists whose works were technical taxonomic treatises, Wilson wrote for a general audience interested in nature (Wilson 1808, preface to vol. 1). He intended his book to entertain and instruct. His style is precise, yet easy and casual. He is always informative, occasionally anthropomorphic, but generally objective and factual. His text is alive with vivid descriptions and metaphors as in the following example from his account of the Passenger Pigeon (Brewer 1839:399–400):

> ". . . In descending the Ohio by myself, in the month of February, I often rested on my oars to contemplate their aerial manoeuvres. A column, eight or ten miles in length, would appear from Kentucky, high in the air, steering across to Indiana. The leaders of this great body would sometimes gradually vary their course, until it formed a large bend, of more than a mile in diameter, those behind tracing the exact route of their predecessors. This would continue sometimes long after both extremities were beyond the reach of sight; so that the whole, with its glittery undulations,

> marked a space on the face of the heavens resembling the windings of a vast and majestic river."

Occasionally he made his point with poetry that ranges from the Song of Solomon, Shakespeare, Marlowe, and others, to doggerel as in the account of Red-winged Blackbirds pulling up germinating corn while the farmer shoots at them (Brewer 1839:281):

> ". . . who live to get away,
> Return to steal, another day."

Wilson also wrote poetry to accompany some of his accounts as in his description of the nesting site of the Pewit Flycatcher (Eastern Phoebe, *Sayornis phoebe*) (Brewer 1839:150):

> "There down smooth, glistening rocks the rivulet pours,
>   Till in a pool its silent waters sleep,
> A dark-browed cliff, o'ertopped with fern and flowers
>   Hangs, grimly lowering, o'er the glassy deep;
> Above through every chink the woodbines creep,
>   And smooth-barked beeches spread their arms around,
> Whose roots cling twisted round the rocky steep;
>   A more sequestered scene is no where found
> For contemplation deep, and silent thought profound;"

Whereas writers of the 18th century viewed nature with awe-filled dread, Wilson softened that view into one of wonder (Huth 1957). Bartram had expressed a similar sympathetic view of nature in his Travels, but Wilson carried his mentor's vision into the scientific discourse (Hunter 1983). His published accounts of his travels (e.g., *The Forresters*) and the literary style of his *American Ornithology* established natural history as an attractive subject for future writers and encouraged an audience for such writing.

Influence on illustration.—Wilson's plates were the first colored illustrations in a text intended for a general audience (Blum 1993). Unlike earlier naturalists Wilson considered drawing integral to observation (Wilson 1811, ix; e.g., sketch and notes of Great Egret, Davis and LeCroy 1994) and he equated illustration with written description as an observational process and a means of communication (Wilson 1808:2, Blum 1993). Furthermore, Wilson insisted on drawing from nature (Wilson 1807 *in* Hunter 1983), by which he meant live or freshly-killed birds, and he insisted on accurate detail (Leslie 1860) to an extent unprecedented in the work of Catesby, Bartram, or Abbot.

Initially his birds appear on isolated twigs, stumps, and clods of earth as had been traditional in European natural history illustrations since the 16th century (Blum 1993). The birds in each plate were arranged in a flat space with no compositional relationship to each other and no consistent scaling from one bird to another. These early plates were typical of contemporary natural history illustrations. Nonetheless, Wilson's birds emphasize the points made in his text. In plate two (Wilson 1808) his nuthatches are in realistic, head-down postures to emphasize behavior described in the written narrative. In plate four (Wilson 1808) a male Orchard Oriole reaches for a hairy caterpillar on the underside of an overhanging leaf. In addition the plate of the Orchard Oriole shows three different male plumages in support of Wilson's proposed unification of several supposed species into one species, the Orchard Oriole. Ecological associations are portrayed, for example in plate twelve (Wilson 1810) a Bobolink perches on a stalk of rice and in plate 21 (Wilson 1811) a grackle pulls a young corn plant from the ground in order to eat the kernel. Such use of illustrations to provide behavioral, ecological, and systematic information in support of the text was new.

Later plates employed landscapes to unify the presentation and expand the visual story. The first landscape appears in plate 23 (Wilson 1811), a stylized millpond and mill backing a kingfisher, but the landscapes appear with increasing frequency in later plates and they become more elaborate, though always stylized. Not one of Wilson's original sketches includes landscapes and, in all probability, the landscapes are a collaboration between Wilson who provides the narrative that establishes the context for the landscape and Lawson who provides the actual elements. Not only do the landscapes give the birds artistic unity, but they locate the animal in nature and help tell a story about each species, for example the Heath Hen (*Tympanuchus cupido cupido*) with an open heath fading into the distance and two Heath Hens courting in the background. Such narration through illustration became the ideal of subsequent naturalist illustrators (Blum 1993) and is Wilson's most influential and lasting contribution to the evolution of ornithological and natural history illustration (Blum 1993). Furthermore his commitment to first hand observation, as expressed in both the text and its illustrations launched a distinctly American approach to the study of the bird as an integral part of nature. Finally, in his last plate (Wilson 1814), a portrait of a Peregrine Falcon (*Falco peregrinus*), Wilson is the artist-naturalist. This is a fine composition that is accurate in detail and artistic in conception and execution. Wilson's legacy as an artist-naturalist is the foundation on which Audubon would create his masterpieces.

Table 4. Occupations of subscribers to Wilson's *American Ornithology* based on biographical information in Cantwell (1961).[a]

OCCUPATIONAL CATEGORIES											
Business		*Education*		*Government*		*Military*		*Professions*		*Miscellaneous*	
type	*no. of subscribers*	*type*	*no. of subscribers*	*type*	*no. of subscribers*	*type*	*no. of subscribers*	*type*	*no. of subscribers*	*type*	*no. of subscribers*
manufacturer/ merchant	58	libraries	22	politician	20	army officer	9	lawyer	39	philanthropist	3
planter/farmer	21	teacher	3	postmaster	2	naval officer	2	doctor	25	naturalist	2
paper maker	2	librarian	1	foreign agent	2	naval agent	4	minister	9	writer	1
bookseller	2	medical society	2	cartographer	1	chief clerk of the navy	1			actor	1
publisher/printer/ binder	10	museum curator	1	interpreter	1					cartographer	1
drugist	2			U.S. president	3					gentlewoman	2
builder/carpenter	4			U.S. treasurer	1					artist	1
auctioneer	3			ambassador	3						
clerk	1			state legislature	1						
banker	4			customs official	1						
insurance broker	3			port collector	1						
inventor	1										
baker	1										
architect	2										
engraver	4										
innkeeper	2										
grocer	1										
watchmaker	1										
stage coach operator	1										

[a] In addition to those subscribers whose occupations are listed above, 162 subscribers have no biographical information.

Economic importance.—The financial success of *American Ornithology* depended on subscriptions from the American public (Table 4) not on royal or noble patronage, as received by Buffon, or the patronage of one or a few wealthy individuals as received by Bartram. Samuel Bradford agreed to publish the *American Ornithology* only if Wilson provided 200 subscriptions, thus Wilson's trips to New York in 1807 and New England in 1808 were devoted to sales as much as to natural history. However, financial success was assured in early 1809 as Wilson travelled through Virginia, the Carolinas, and Georgia where he obtained 250 subscriptions. On his return to Philadelphia he revised volume 1 (Faxon 1901) and printed 300 copies in addition to the original 200 printed in September 1808, before his southern trip. The number of subscribers eventually reached 450. As important as the number was their diversity (Table 4). Wilson not only proved that the public would support the publication of natural history, he showed that such support did not depend on a single group within the American economy. Furthermore, through his efforts—he visited 15 of 18 states, every major city, and every university in the United States—he built a market for the publication of natural history. This was the market exploited by Bonaparte, Audubon, Nuttall, and others in subsequent years. In addition to its purely economic innovation, the *American Ornithology* was a demonstration of the excellence of American publishing. Wilson emphasized this point in his prospectus (Hunter 1983:268–272):

> "The work will be printed in large Imperial Quarto, on a rich vellum paper, . . . the type for the letter-press is entirely new, and of singular beauty: . . ."

He emphasized it again in the preface, pointing out that the "rich vellum paper" was made in America, that the type "entirely new, and of singular beauty" was designed in Philadelphia, that, as in French printing, some of the plates were printed in colored inks to give the plumage softness and avoid muddying the colors when the plate was painted. And later when the Peales began to produce their own watercolors, Wilson not only used these but, in the preface to volume 3, let his readers know that even the colors of the plates derived from local manufacture.

In the end Alexander Wilson must be considered the first great public ornithologist, the first to describe and illustrate the birds of North America within a framework of knowledge that provided for the distinctive growth of a North American ornithology based on the observation of living birds. In his travels and his books, in the realism of his art and the accessibility of his descriptions, Wilson showed America her birds. Public support for the *American Ornithology*, which far exceeded Bradford's

200-subscriber goal, demonstrated an awakening interest in nature, in general, and ornithology, in particular, an interest that continues to grow.

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Origins and Development of North American Avian Biogeography[1]

François Vuilleumier[2]
and
Allison V. Andors[2]

ABSTRACT.—This chapter reviews the literature of American ornithology since the 18th century in an attempt to discern the origins and developmental trends in North American avian biogeography. We identify several periods in the history of North American avian biogeography. These include two partly overlapping Early Periods in which the science originated (1840s–1890s) and then developed (1870s–1920s), a Middle Period (1920s–1960s) characterized by continued growth and some innovation, and a Recent Period of great diversification, from the 1960s onward. We trace several parallel and anastomosing chains of intellectual influences that stem from early authors like Louis Agassiz and Spencer Fullerton Baird, continue through Joel A. Allen and Frank M. Chapman, and finally radiate into several schools of thought. Among these are the static school, the post-Wallacean dispersalist school, the qualitative island biogeography school, the dynamic insular equilibrium school, and the vicariance biogeography school. We conclude that each of these schools was initiated by authors who were reacting negatively to the work of some predecessors, and wanted to create other lines of approach.

This review traces the origins and development of North American avian biogeography, which we define as the description of distribution patterns of North American bird taxa or faunas and their subsequent causal analysis (cf. Vuilleumier 1985a:669 for a similar definition of zoogeography; the more broadly encompassing term biogeography is here preferred; cf.

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[1] The authors wish to dedicate this chapter to Ernst Mayr on his ninetieth birthday.

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Simberloff 1983:411). When did avian biogeography begin as a scientific discipline in North America? Who were the major ornithogeographers of the 18th, 19th, and early 20th centuries? If Alexander Wilson (1766–1813) was the "father of American ornithology" (J. A. Allen 1876:547, E. G. Allen 1951:552), then who was the father of North American avian biogeography? Who were his predecessors, his successors, and in what directions did American avian biogeography develop? What are the relationships between early North American avian biogeography and more recent biogeographic trends? In this chapter we suggest answers to these questions.

The literature since the 1850s permits an assessment of the relative importance of schools of thought in North American avian biogeography. It enables the unraveling of part of the complex web of personal and intellectual influences that determine how scientists produce new syntheses. Such a study shows shifts of institutional focus from research museums to universities as centers of biogeographic research. It also reveals the apparent—and periodic—need for some biogeographers to reject earlier concepts in order to impose new views that are supposedly closer to the truth.

Aspects of the history of biogeography were discussed by Hofsten (1916), Schmidt (1955), Nelson (1978), Croizat (1981), Larson (1986), and Llorente (1991), and recent trends by Keast (1991). Keast (1977), Vuilleumier (1975, 1990), and Simberloff (1983) published essays on the history of avian biogeography. Accounts of the history of ornithology, with consideration of the history of avian biogeography, include those by Newton (1893–1896), Boubier (1925), Mayr (1975), Stresemann (1975), and Farber (1982).

THE EARLY PERIOD OF NORTH AMERICAN AVIAN BIOGEOGRAPHY

In the late 18th and the first half of the 19th century an emphasis was placed on collecting birds all over North America. These collections formed the basis for taxonomic descriptions and faunal lists. Early American ornithologists were concerned with the geographical origin of taxa, determined by the locality data on voucher specimens that were deposited, first in private collections, and later in public museums. This interest in faunistics was shared by such important figures as Mark Catesby (1682–1749) and Alexander Wilson, as well as John James Audubon (1785–1851) (Murphy 1956), William Bartram (1739–1823), Charles Lucien Jules Laurent Bonaparte (1803–1857), the "father of systematic ornithology in America" (Palmer 1928:269), Thomas Nuttall (1786–1859), John Cassin (1813–1869), and Elliott Coues (1842–1899) (J. A. Allen 1909). Systematic revisions and annotated faunal lists are still published today but they no longer dominate ornithology. Nevertheless, descriptions of distributional patterns of species in local faunas (e.g., Johnson 1965, Johnsgard 1979, Pitelka 1974), and taxonomic revisions and subsequent phylogenetic reconstructions of relationships among taxa of various ranks (e.g., Zink et al. 1991, Peterson 1992, Sheldon et al. 1992), still serve as a fundamental framework for biogeographic analysis. It is important to realize that the primary data used by both early and contemporary biogeographers, taxa and their ranges, are rooted in classification and phylogenetic schemes and are bound by geographical and ecological limits.

East Coast School.—As soon as museum scientists had sufficient specimens available to perceive distributional patterns, they elaborated biogeographical schemes dividing North America into faunal units and subunits. This activity started in the eastern U.S. about 150 years ago with Louis Agassiz (1807–1873, Fig. 1) (L. Agassiz 1845a, 1850a,b, 1854), the founder of the Museum of Comparative Zoology (MCZ) at Harvard University (E. C. Agassiz 1885, Lurie 1960; chapter 3 this volume). Several important museum scientists of that period were influenced by Agassiz. For example, Albert S. Bickmore (1839–1914), the founder of the American Museum of Natural History (AMNH) (Hellman 1968:9), was Agassiz's pupil at Cambridge (Osborn 1911:9), and Addison Emery Verrill (1839–1926), the developer of a zoological museum out of the old "Natural History Cabinet" at Yale University (Coe 1932:23), was Agassiz's assistant at the MCZ. In a paper written when he was 27 years old, Verrill (1866:260) "found that the boundaries between the Canadian and Alleghanian Faunae, . . . are coincident with a line which shall indicate a mean temperature of 50° Farenheit [sic], during the months of April, May, and June." He also discovered that the 65°F mean temperature line "coincides with a boundary between the Alleghanian Fauna and that of the Southern States, or Louisianian Fauna." Verrill's faunal terminology was apparently derived from that of Agassiz (1845a, 1854). Because Louis Agassiz's influence on biogeography in America was substantial, he could perhaps be called the "founder of American biogeography," just as Catesby was called the "founder of American ornithology" (E. G. Allen 1951:463).

The first ornithologist to divide North America into faunal districts was probably Spencer Fullerton Baird (1823–1887, Fig. 2) (Billings 1895, Dall 1915), who followed a regional classification proposed by Louis Agassiz (Baird 1859, 1866). Baird's collections "formed the nucleus of the present National Museum" (Billings 1895:145). He served as Assistant Secretary of the newly organized Smithsonian Institution from 1850 onward and was Secretary from 1878 to 1887. Because of his activities as an administrator, collector and writer, he is considered to be head of the "Bairdian

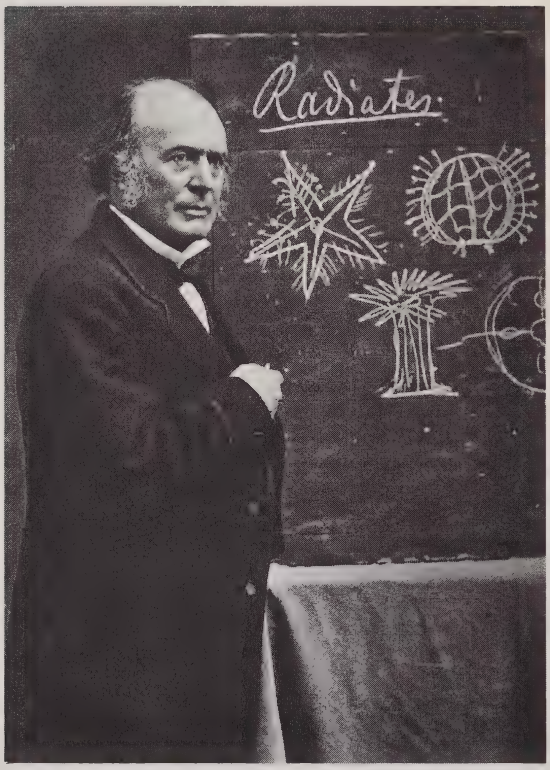

Fig. 1. Louis Agassiz (1807–1873), date unknown. Courtesy AMNH.

period" of ornithology (Coues 1884:xxv, Haffer 1992:128) which was part of the "Bairdian epoch" of American ornithology according to Coues's nomenclature (Coues 1884:xxiii). Coues (1884:iii) referred to him as the "Nestor of American Ornithologists."

Baird (1866:89) concluded "that the ornithological provinces of North America consist of two great divisions of nearly equal size in the United States, meeting in the vicinity of the 100th meridian, the western half divisible again into two, more closely related to each other than to the eastern, though each has special characters." In addition, Baird (1866:89) stated that "A northern or sub-arctic fauna mixes with and melts into the three, extending far to the south (even into Mexico) along the Rocky mountains."

Baird's protégé, Robert Ridgway (1850–1929) (Harris 1928, Oberholser 1933), a systematist and curator of birds at the U.S. National Museum for five decades, published little in biogeography (e.g., Ridgway, 1873, 1874, 1877) notwithstanding his authorship of most of *The Birds of*

Fig. 2. Spencer Fullerton Baird (1823–1887), ca. 1875. Courtesy Smithsonian Institution Archives, Record Unit 95, Photograph Collection 1850s– .

North and Middle America (Ridgway et al. 1901–1950) (Wetmore 1934). This authoritative treatise should have given him a unique basis for biogeographic syntheses on North American birds. Similarly, Carl Eduard Hellmayr (1878–1944) (Zimmer 1944) authored most of the *Catalogue of Birds of the Americas* (Cory et al. 1918–1949), yet never published biogeographic interpretations of these basic systematic and geographic data.

From ca. 1871 to 1900, the major zoogeographer in North America was Joel Asaph Allen (1838–1921, Fig. 3) (J. A. Allen 1916, Chapman 1927), who published seminal papers on the distribution and origin of North American birds (1871, 1872, 1880, 1890, 1892a, 1893) and mammals (1878, 1892b), as well as critical reviews and notes (e.g., 1876, 1894, 1895). Allen was curator of birds in the MCZ at Harvard (where he had met Louis Agassiz as early as 1862), and later (1885–1920) head of the Department of

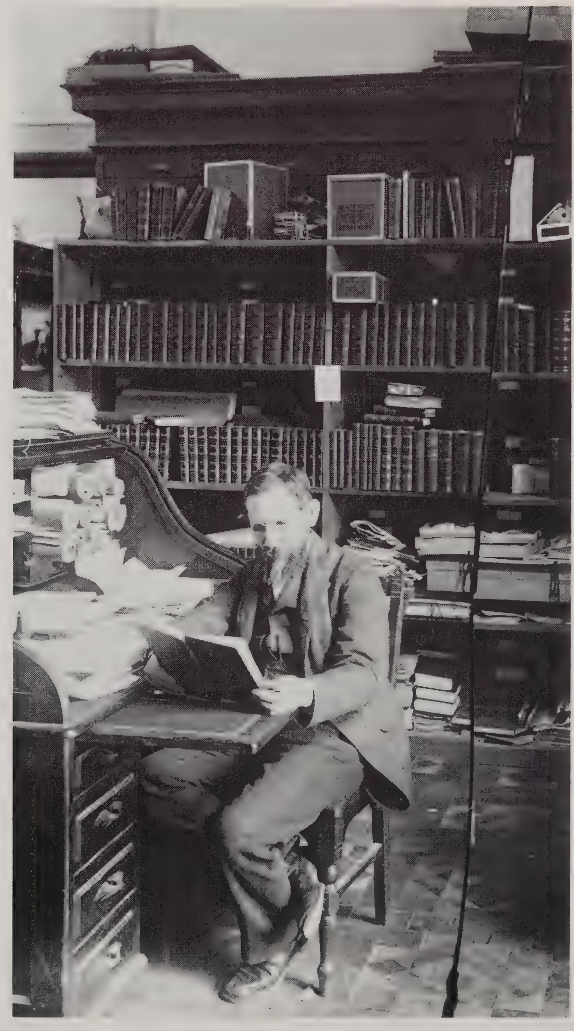

Fig. 3. Joel Asaph Allen (1838–1921), AMNH, date unknown. Courtesy AMNH.

Mammalogy and Ornithology at the AMNH in New York. He edited the *Bulletin of the Nuttall Ornithological Club* (BNOC) from 1876 to 1883 and, after the BNOC became *The Auk*, he edited that journal from 1884 to 1912. For 32 years, beginning in 1889, he simultaneously edited the *Bulletin* and the zoological series of the *Memoirs* of the AMNH. One of the co-founders, he has been called the "Father of the American Ornithologists' Union" (Chapman 1927:5, Stone 1954:9), and he could easily be called the "father of American avian biogeography."

Many contemporary biogeographers might think of Allen as "only" a museum man, but he did much collecting in western North America in the 1870s, when fieldwork was made so dangerous by hostile natives that expeditions had to be accompanied by military escorts. As Chapman (1927:4), writing about Allen's trips, put it, "The present-day naturalist, who travels in palatial steamers or follows well-worn trails, has but faint conception of the discomforts of a 90-day voyage in a small sailing vessel and has perhaps never experienced the risk of being himself collected."

Allen was perhaps most influenced by Louis Agassiz, but also by other biogeographers including L. Schmarda in Germany (1853), Philip L. Sclater in England (1858, 1875, 1891), and Angelo Heilprin (1887) and C. Hart Merriam (1895) in the U.S.

In what was probably his major avian biogeographic synthesis, Allen (1893) not only subdivided North America into regions and provinces but also, importantly, addressed the question of the origins of the avifauna of North America. He identified "four prominent elements": (1) northern hemisphere, (2) intertropical ("tropicopolitan"), (3) tropical American, and (4) autochthonous (J. A. Allen 1893:115). The last element "is made up partly of strongly modified Old World types, but mainly of peculiar genera, or at least peculiar species, which entered our borders partly by way of the West Indies, but mainly by way of Central America and Mexico" (J. A. Allen 1893:115). Among the autochthonous or indigenous genera, Allen (1893:116) included *Sphyrapicus* woodpeckers, *Aphelocoma* jays, *Xanthocephalus* blackbirds, *Melospiza* sparrows, and *Seiurus* warblers.

While at the American Museum, Allen hired Frank M. Chapman (1864–1945, Fig. 4), who became one of the premier ornithologists in North America, chairman of the Department of Ornithology of the AMNH from 1920 to 1942, and a biogeographer of the first rank (chapter 5 this volume). Chapman's biogeographical work focused more on the South American than on the North American fauna, but in an important early paper (Chapman 1892) he discussed West Indian zoogeography in reference to mainland North and Central American birds. In the first and second parts of this paper, Chapman described respectively the avifauna and the mammalian fauna of southern Cuba. In the third part (pp. 318–330), he took up the general problem of the origin of West Indian birds. He divid-

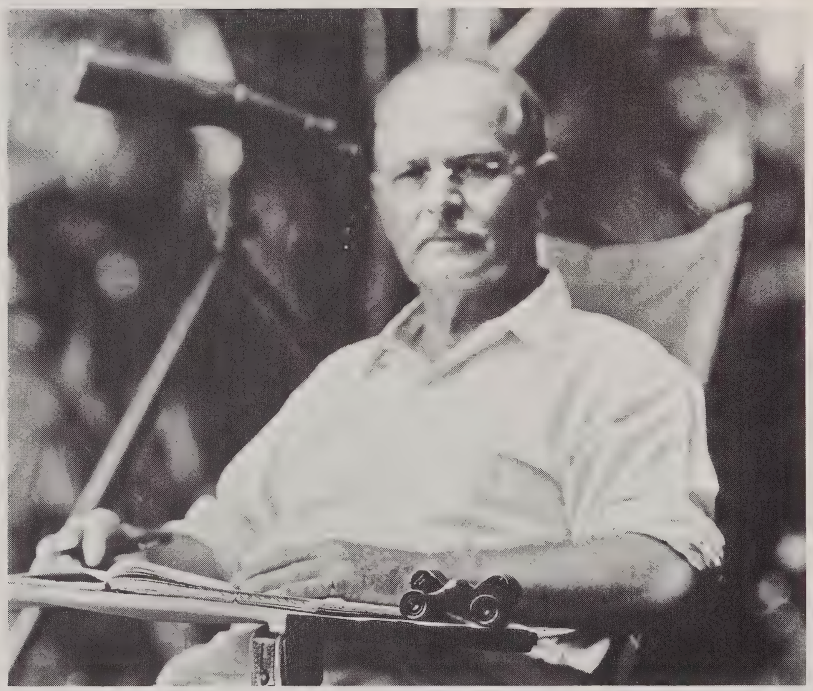

Fig. 4. Frank M. Chapman (1864–1945), Barro Colorado Island, Panama, date unknown. Courtesy AMNH.

ed the non-endemic fauna into elements showing the North American element, mostly nonbreeding migrants, to be numerically predominant (160 of 248 species and subspecies). Chapman (1892:319) stated that although these birds "will, in some instances, show us the sources from which the more recent West Indian species have been derived, [they] will not aid in determining the origin of the more distinct species which may have become West Indian under physiographic conditions not now prevailing." Hence Chapman turned his attention to the endemics, noting that "It is only by a study of the endemic species that we may hope to gain some understanding of the past history of the islands" (Chapman 1892:319). Chapman noticed that the West Indian avifauna was depauperate with respect to mainland source areas. Of the 12 families of birds which are common on the mainland but which, with two exceptions, are absent from the West Indies, Chapman remarked that "these birds are either terrestrial or of sedentary habits" and that, therefore, "we should not expect to find [them] occupying a prominent place in an insular avifauna." The problems that Chapman addressed 100 years ago were taken up again by James

Bond (1900–1989; see Parkes 1989) in several synthetic papers (Bond 1934, 1948, 1963, 1979).

Chapman's influence on American ornithology and American biogeography was considerable (Gregory 1948, Murphy 1950, Zimmer 1946). Some of Chapman's biogeographic papers on tropical American birds are classics, e.g., the essay on the Momotidae (Chapman 1923), or the treatise on Ecuadorean birds (Chapman 1926). Chapman surrounded himself with a staff of extraordinary scientists at the AMNH. For example, he hired Ernst Mayr (1904–) in 1931, who became preeminent in contemporary biogeography—and in evolutionary biology in general (Gould 1984).

The main school of thought in biogeography in the last two decades of the 19th century and the first two or three of the 20th was under the preponderant influence of museum ornithologists and systematists like Allen and Chapman. The AMNH, where these workers were based, had by far the largest collection in the U.S.: already about 685,000 study skins in the early 1930s, against "only" 252,000 at the U.S. National Museum, 250,000 at the MCZ, and 110,000 at the Academy of Natural Sciences in Philadelphia (Peters 1933:132). Thus, because of its staff and collections, the AMNH became the intellectual center of avian biogeography. This was also true of mammalian biogeography, partly because Allen was also a mammalogist, publishing important papers on mammalian biogeography (J. A. Allen 1871, 1878), and partly because the paleomammalogist William Diller Matthew (1871–1930), author of a seminal essay entitled *Climate and Evolution* (1915), was likewise at the American Museum.

Matthew's influence on North American biogeographers of the dispersalist school, e.g., Philip Jackson Darlington, Jr. and George Gaylord Simpson of the MCZ at Harvard, was substantial. Simpson, especially, regarded Matthew as his mentor, noting that "I was trained [informally] by Matthew [in the field] at least as much as by my major formal professor [at Yale University, Richard Swann] Lull" (Simpson 1978:34; see Laporte 1985:274 concerning Simpson's intellectual independence from Matthew's biogeographical views). In 1927, Matthew recommended that Simpson be "brought in at the bottom of the [American Museum's] department [of Geology and Paleontology] when he [Matthew] went out at the top" (Simpson 1978:38) and assumed a teaching position at the University of California at Berkeley. From 1927 until 1959, when he went to MCZ, Simpson worked at the AMNH (Simpson 1978). Although Darlington was primarily a beetle specialist (Darlington 1971, Ball 1985, Moore 1985) and Simpson a paleomammalogist, both made contributions to avian biogeography and to biogeographical theory. Darlington's (1957) *Zoogeography: The Geographical Distribution of Animals* is a classic and contains a chapter on avian distribution. His evolutionary and biogeographical accomplishments are reviewed by Brown (1985). Important works on general

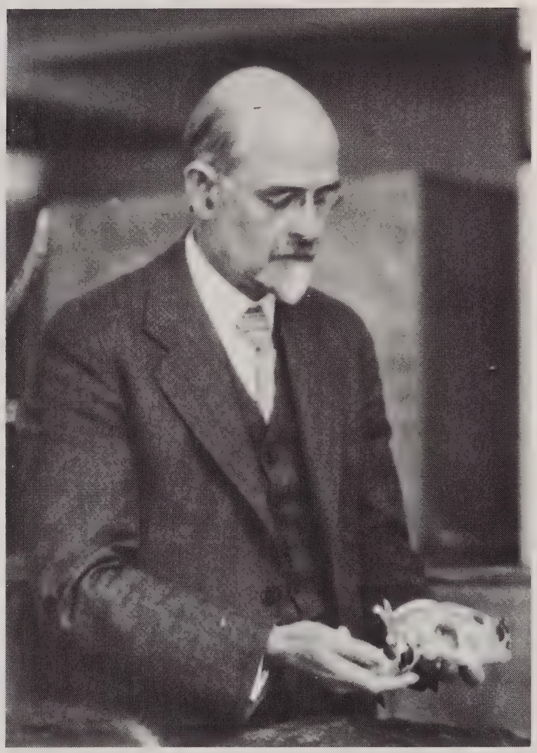

Fig. 5. Joseph Grinnell (1877–1939), December 1930, photographer G. E. Hoover. Courtesy N. K. Johnson, MVZ.

biogeography published by Simpson include *Mammals and Land Bridges* (1940) and *Evolution and Geography* (1953). His contributions to avian biogeography include a series of papers on fossil penguins (Spheniscidae; Simpson 1975 and works cited therein).

West Coast School.—Another school of thought developed in California under the leadership of Joseph Grinnell (1877–1939, Fig. 5) (Hall 1939, H. W. Grinnell 1940, Linsdale 1942, Miller 1964), who published numerous faunal monographs (incl. J. Grinnell 1902, 1908, 1913, 1914a, 1915, 1928, Anderson and Grinnell 1903) and a few theoretical or synthetic papers (J. Grinnell 1914b, 1917a,b, 1924, 1927, 1935; Hall and Grinnell 1919).

Grinnell was primarily interested in documenting the geographic distribution of birds in the western U.S., especially California, and in summarizing patterns in the form of zonal maps (e.g., Hall and Grinnell 1919, J.

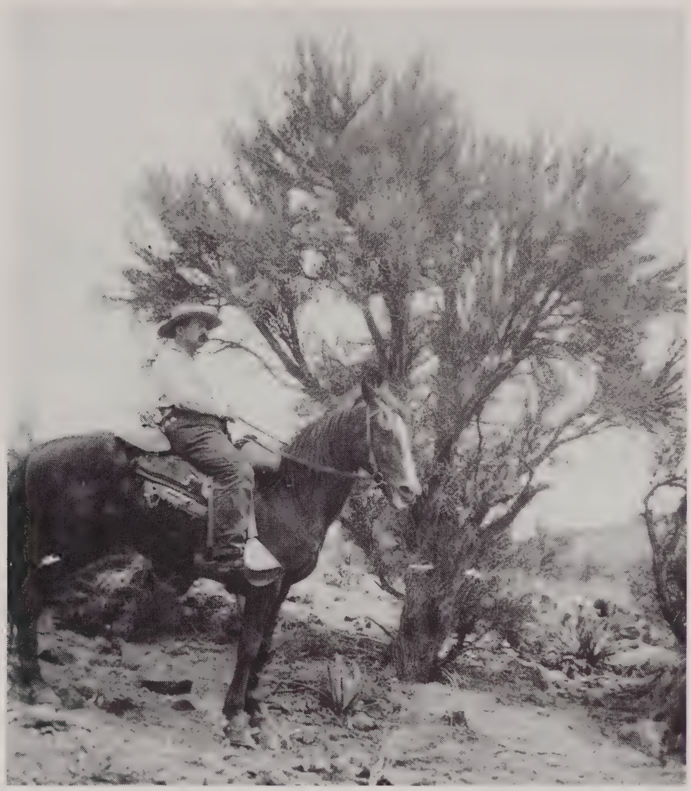

Fig. 6. C. Hart Merriam (1855–1942), Arizona, July 1896. Courtesy Smithsonian Institution Archives, Record Unit 7150, American Ornithologists' Union Collection, 1883–1977.

Grinnell 1935). Although Grinnell is usually better remembered for his introduction of the niche concept in his analysis of the habitat preference of the California Thrasher (*Toxostoma redivivum*; J. Grinnell 1917b) than for his biogeographic theories, Griesemer (1990) has argued that his meticulous field and museum work was directed toward answering general biogeographical and evolutionary questions.

Grinnell's biogeographical analyses were modeled after those of C. Hart Merriam (1855–1942, Fig. 6), whose work was based at the Biological Survey in Washington, and who did extensive field work in the Southwest. According to Hilda Wood Grinnell (1940:8) Merriam's "writings were Joseph [Grinnell]'s gospel." Some of Merriam's papers (Merriam 1890, 1892, 1895) were widely cited. J. A. Allen used them in his analyses, as did Chapman in his Andean work. Grinnell, in a letter to AMNH president

Henry Fairfield Osborn, wrote that Allen's influence on the West Coast was second to that of no other ornithologist (Chapman 1927:13).

Grinnell, who had a Ph.D. from Stanford University, and was director of the Museum of Vertebrate Zoology (MVZ) at the University of California at Berkeley from 1908 until his death in 1939, was one of the few major avian biogeographers of the early 20th century to be an academically trained biologist (Chapman was not; Mayr 1975:369). Grinnell started the West Coast School or "MVZ School" of ornithology (Mayr 1973:196) which continued with Alden H. Miller (1906–1965) (Davis 1967, Mayr 1973, Pitelka 1993; chapter 8 this volume). Linsdale (1942:269) wrote that Grinnell "took a large part in bringing the study of birds to the level of importance such that many people thought of it as a prospective profession."

In 1908, Grinnell invited Harry Schelwald Swarth (1878–1935, Fig. 7), a young assistant at the Field Columbian Museum in Chicago, to join the curatorial staff of the MVZ (Linsdale 1936:157). Swarth developed the compelling interest in geographic distribution and variation in the birds and mammals of western North America that was to dominate the rest of his career at the MVZ (1908–1912, 1916–1926), the Museum of History, Science and Art in Los Angeles (now Los Angeles County Museum) (1913–1916), and the California Academy of Sciences in San Francisco (1927–1935). Swarth was primarily a systematist and made important contributions to the ornithogeography of California (Grinnell and Swarth 1913), Arizona (Swarth 1914), the northwest coast of North America (Swarth and Brooks 1925), and the Galapagos Islands (Swarth 1931, 1934).

MIDDLE PERIOD OF NORTH AMERICAN AVIAN BIOGEOGRAPHY

After modest but intellectually vigorous beginnings, American biogeography developed by quantum leaps. Although early avifaunal analyses were focused on the description of faunal realms, provinces, or zones, whether latitudinal (J. A. Allen 1893) or altitudinal (Merriam 1890), they were deeply rooted in ideas about the origins of distribution patterns. Thus, biogeographers like Allen, Chapman, and Merriam were not content merely to draw boundaries between faunal realms or provinces. They investigated the *origins* of faunas. Some authors (Dunn 1922, 1931, Mayr 1946) have given the impression that these early workers were simply describers. This exaggeration was perhaps a reaction to a perceived need for a "breath of fresh air" in their science; hence their desire to discard what they saw as static regional biogeography, and to replace it with a

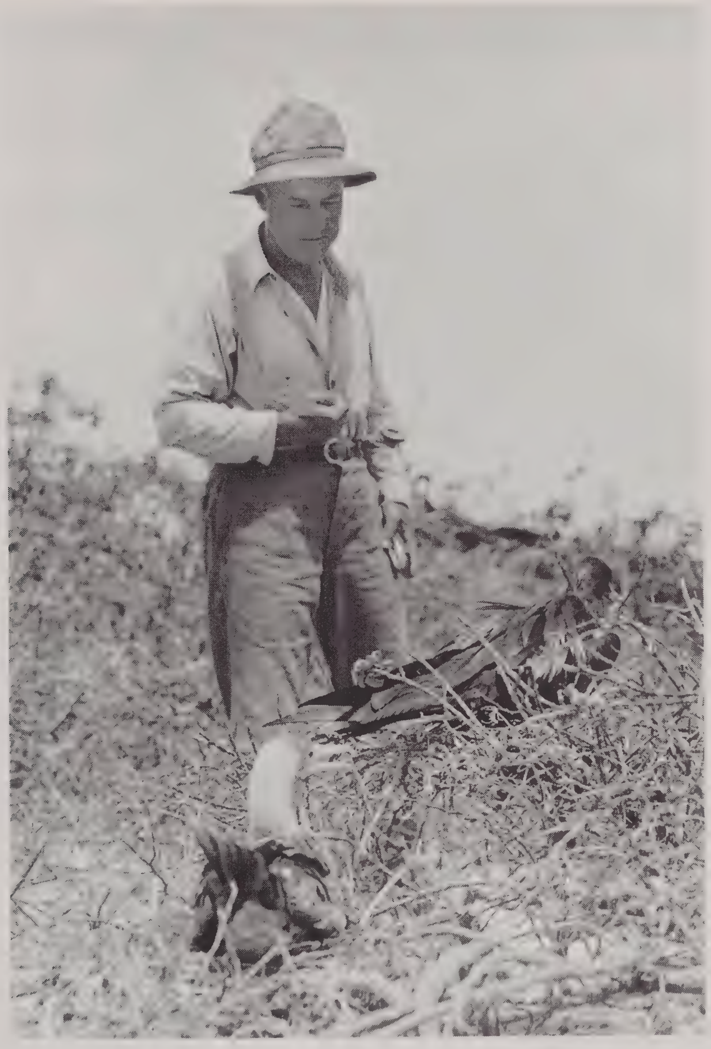

Fig. 7. Harry Schelwald Swarth (1878–1935), Tower Island, Galapagos, Crocker Expedition, ca. 1932. Courtesy California Academy of Sciences, Special Collections.

Fig. 8. Einar Lönnberg (1865–1942), date unknown. Courtesy of S. Rosén, editor, *Fauna och flora.*

dynamic biogeography based on the analysis of faunal elements.

The first major synthetic work on the origins of the North American bird fauna since Allen's pioneering efforts was published (Lönnberg 1927) by the Swedish vertebrate biologist Einar Lönnberg (1865–1942; Fig. 8) (Hanström 1942). Lönnberg worked at the Göteborg Museum of Natural History from 1891 to 1903 and moved to the Royal Natural History Museum in Stockholm where he remained from 1904 until his retirement in 1933. Lönnberg's only other major biogeographic essay was on the evolution of the African bird and mammal faunas (Lönnberg 1929). Mayr's landmark paper on the origins of the North American avifauna (Mayr 1946) attempted to update Lönnberg's seminal study, which had curiously remained largely unnoticed to that day.

Lönnberg's 1927 paper did not cite the earlier work of biogeographers like Baird, Merriam and Allen. Instead, Lönnberg's analysis was predicated on the view that North American birds can belong to one of three main categories: (1) endemic birds, (2) descendants of immigrants from the Old World, and (3) descendants from South America. He used the term endemic to refer to taxa (Chamaeidae, *Aphriza*, Mimidae, Vireonidae, Parulidae, Bombycillidae, Ptilogonatidae, Troglodytidae, Icteridae, Picidae, Momotidae, Odontophoridae, Tetraonidae) that he believed had "really originated within the [North American] region and had their centre of radiation situated there" (Lönnberg 1927:7), as opposed to other North American taxa that were known or suspected to have immigrated to that continent from elsewhere.

Mayr (1946) also divided the North American avifauna into elements but his classification was more finely subdivided than Lönnberg's and included six elements: (1) unanalyzed, (2) pantropical, (3) panboreal, (4) Old World, (5) North American, (6) pan-American, and (7) South American. Mayr assigned to his North American element all of the taxa included in Lönnberg's North American category except for *Aphriza*, Icteridae, and some Picidae. Mayr also added the Cathartidae, the Meleagrididae (but note that Lönnberg 1927:19–20 hesitated about allocating the turkeys to his North American category), the Aramidae, the Todidae, the Cinclidae, the Polioptilinae, the Dulidae, and the Emberizinae.

Following Mayr's 1946 analysis, Ludlow Griscom (1890–1959; Fig. 9; Peterson 1965); grouped the birds of Mexico into a number of faunal elements to unravel their origins (Griscom 1950). On the basis of a still more finely divided (species-level) biogeographical classification than Mayr's, Griscom reached at times different conclusions. For example, whereas Mayr (1946:27) listed the Trochilidae and Tyrannidae as pan-American elements of probable South American origin, Griscom (1950:378) pointed out that "Warm North America has been a major evolutionary center for both [families]." In a later essay Mayr (1964a) stated that a distinction should be

Fig. 9. Ludlow Griscom (1890–1959), February 1917. Courtesy AMNH.

made between a center of first origin and a center of secondary radiation.

Mayr and Short (1970) analyzed the biogeography of species of North American birds in terms of a "zoogeographical species" concept which they defined as "either superspecies . . . or individual species not belonging to a superspecies" (Mayr and Short 1970:3). They identified several distributional categories among superspecies (see especially their Table 7, p. 102). Most recently, Ouellet (1990a,b) published speculations on the origins of Canadian birds in general, and of Canadian Arctic archipelago birds in particular, and Keast (1990a,b) discussed the biogeography of North American forest birds.

In the analyses of Lönnberg, Mayr, Griscom, and Ouellet faunal elements were taxa allocated to geographic areas, whereas other workers used a more ecological approach. For example, the Russian Boris Stegmann (1898–1975; Kumari 1976) subdivided the Palearctic avifauna into faunal types which have largely political designations, but which are in fact based on the biomes of this region (Stegmann 1938). Thus, Stegmann's European faunal type is composed of birds living in the deciduous forest biome, and his Siberian faunal type includes species living in

Fig. 10. Miklos D. F. Udvardy, aboard the U.S. Coast Guard Cutter *Winnebago* at Laysan, July 1959. Courtesy M. D. F. Udvardy.

the taiga biome. The ecological approach developed by Stegmann (1938) was not picked up in North America until 20 years later, when Miklos D. F. Udvardy (1958:54; Fig. 10) divided the North American avifauna into faunal groups based on major biomes including the tundra, the taiga, and open grasslands. In two papers subsequent to his 1946 analysis, Mayr (1964a,b) added an emphasis on ecology to his taxonomic approach.

In an important paper published only three years after Stegmann (1938) but carried out independently, Pitelka (1941) analyzed a sample of North American species which he assigned to the major North American biomes. Pitelka did not cite Stegmann but was inspired by early workers like Merriam (1890) and especially by criticisms of Merriam's work by ecologists like Victor Ernest Shelford (1877–1968) (Croker 1991), who helped develop the biome concept. Indeed, Pitelka prepared his paper under the supervision of S. Charles Kendeigh who was Shelford's successor at the

Fig. 11. Alden H. Miller (1906–1965), date unknown. Courtesy N. K. Johnson, MVZ.

University of Illinois.

Pitelka subsequently went to California where he became a student of Alden Holmes Miller (1906–1965; Fig. 11) (Davis 1967). Miller was an intellectual descendant of Joseph Grinnell and had been his Ph.D. student. Grinnell and Miller can be considered the chief architects of the MVZ school of ornithology (Mayr 1973) and also what we call a West Coast School of North American avian biogeography.

Miller succeeded Grinnell in 1940 as director of the MVZ at Berkeley after the latter's death in 1939 and served in this capacity until his own death in 1965. Grinnell "was, without doubt, the single most important influence on Alden [Miller]'s career" (Davis 1967:196). Miller emulated Grinnell's work ethic and analytic ability. In turn, Miller passed along this tradition to his own students, including many prominent North American ornithologists, listed in Mayr (1973:196), Pitelka (1993), and chapter 8 this volume.

Miller's work in North American biogeography was carried out along two lines. He (1) analyzed in great detail the geographical distribution and speciation of avian genera, especially *Junco* (Miller 1934, 1941), and (2) was interested in the origin of the avifaunas of California. For example, he attempted to place the Pleistocene birds of California into a scheme of life-zones (Miller 1937). His most important biogeographic paper is his analysis of the distribution of California's birds (Miller 1951). He returned to the life-zone system of Grinnell and earlier authors and assigned each species of breeding California bird to one or more life-zones and to "ecologic formations" which are in effect vegetation types. For example, in his "Scrub group" he included desert scrub, sagebrush, and chaparral, and in his "Woodland group" he included piñon-juniper woodland, oak woodland, and riparian woodland. Finally, he assigned the species in the avifauna of California into four groups: "boreal," "Great Basin," "Sonoran," and "Californian." Each group was subdivided into a number of geographical subunits called "subfaunas." Miller emphasized Pleistocene climatic and vegetational changes and geographical isolation as factors that affected the historical and Recent distribution of California's birds.

Among Miller's students who worked on biogeographic problems of North American birds are Frank A. Pitelka (Pitelka 1941), Charles G. Sibley (speciation in the red-eyed towhees *Pipilo erythrophthalmus* and *P. ocai*, Sibley 1950), Albert Wolfson (reanalysis of Mayr's 1946 paper in terms of continental drift, Wolfson 1955), Joe T. Marshall, Jr. (birds in pine-oak woodland, Marshall 1957), Thomas R. Howell (Central American birds, Howell 1969), Ned K. Johnson (Johnson 1975), and Robert K. Selander (speciation in wrens of genus *Campylorhynchus*, Selander 1964, and avian speciation in the Quaternary, Selander 1965).

RECENT PERIOD OF NORTH AMERICAN AVIAN BIOGEOGRAPHY

After World War II, biogeography in North America shifted from museum ornithologists, who were primarily systematists, to ornithologists based at research universities, who were primarily ecologists. Museum specimens, which had been the *sine qua non* material of biogeographic research until the mid-1950s, decreased in importance as biogeography became more ecologically oriented. As museum collections grew (Peters 1933) and knowledge of distribution and taxonomy of North American birds increased, geographical and systematic explorations diminished and emphasis shifted to more ecological problems. Without the fundamental geographic and systematic information embodied in museum specimens, however, the shift could not have taken place (Sibley 1955:630). A change in time scale also occurred. Whereas museum-based biogeographers used an evolutionary time scale, ecologically oriented ones focused on a shorter time scale (ecological time). The change in emphasis was not abrupt, nor was it complete.

During the early part of the Recent Period biogeographical analyses of North American birds were carried out by Robert M. Mengel (1921–1990) (Tordoff 1991) of the University of Kansas Museum of Natural History and by John P. Hubbard at the Delaware Museum of Natural History. Mengel wrote seminal papers (Mengel 1964, 1970) dealing respectively with the geography of speciation in wood warblers (Parulidae [=Parulinae]) and the role of the Central Plains as an isolating factor in avian distribution and speciation. Recently, Bermingham et al. (1992) tested Mengel's (1964) model of parulid speciation by analyzing mtDNA relationships among species in the Black-throated Green Warbler (*Dendroica virens*) complex. Hubbard discussed the origins of the Appalachian avifauna (Hubbard 1971) and of the arid lands of North America (Hubbard 1973). Both Mengel and Hubbard were influenced by Austin L. Rand (1905–1982) (Traylor et al. 1984, Godfrey 1988) of the Field Museum of Natural History, author of a paper on the role of glaciation as an isolating factor in North American biogeography (Rand 1938).

At about the same time as the papers by Mengel and Hubbard appeared, ornithologist and population biologist Robert H. MacArthur (1930–1972) (Fretwell 1975) at the University of Pennsylvania, and entomologist Edward O. Wilson (1929–) at Harvard University, published studies of distribution patterns of species and species numbers on islands (MacArthur and Wilson 1963, 1967). Their analyses were in terms of a dynamic equilibrium theory akin to life and death processes in population ecology. Borrowing ideas from authors like Volterra (1926) and Lotka (1956), who used integro-differential equations to model the growth of populations, MacArthur and Wilson built a new mathematical theory of biogeography that drew analogies between the birth and death rates in the Volterra population equations and the rates of immigration and extinction of species populations on islands.

The dynamic equilibrium theory has been severely criticized (Gilbert 1980, Simberloff 1980, Olson 1990) and the mathematical treatment, which was the novel part of the theory, is now considered inadequate. But after MacArthur and Wilson's paper appeared in *Evolution* (1963) and especially after their book, *The Theory of Island Biogeography*, was published (1967), their theory led to two decades of intensive, almost frantic, research into insular biogeography and geographical ecology. In North America these efforts were carried out either on truly insular avifaunas, e.g., those of the Channel Islands of California (Diamond 1969), or on those of mountaintops considered as ecological islands, e.g., the montane boreal avifaunas of the Great Basin (Johnson 1975, Brown 1978). Some of Diamond's 1969 results concerning the Channel Islands' avifauna, especially that turnover rates were high and therefore consonant with MacArthur and Wilson's equilibrium theory, were challenged by Lynch and Johnson (1974). This controversy was reviewed by Vuilleumier (1975:466), who concluded that "we are not in a good position to assess turnover rates in island avifaunas until a critical analysis of turnover parameters using several methods of measuring these parameters has been carried out."

A former student of Wilson's and an early follower of MacArthur, Daniel S. Simberloff, became worried about the lack of statistical rigor in many biogeographical analyses and insisted that null hypotheses be constructed whenever patterns were being explained (Connor and Simberloff 1978). Simberloff (Connor and Simberloff 1979) claimed that some of Diamond's (1975) rules of assembly of species communities on islands were not substantiated by available evidence. Simberloff's views were later rebutted by Diamond and Gilpin (1982).

The continuing efforts of avian paleontologists like Alexander Wetmore (1886–1978) (Olson 1976, Oehser 1980, Ripley and Steed 1987), Hildegarde Howard (1901–) (Campbell 1980), and Pierce Brodkorb (1908–1992) (Campbell 1992, Olson 1993) to accumulate basic distributional and systematic data on North American fossil birds (e.g., Wetmore 1940, 1951, 1956, 1959, Howard 1950, Brodkorb 1963, 1964, 1967, 1971a, 1971b, 1978) were largely independent of other developments in American biogeography. Indeed, the great value of fossil birds in biogeographical reconstructions was not appreciated by biogeographers working with Recent birds until a large body of data had accumulated (e.g., Becker 1987). Thus it is only in the last decade or two that avian paleontology has advanced to the point where preliminary biogeographic syntheses based on fossil birds have been attempted (e.g., Cracraft 1973, Vuilleumier 1985b, Vuilleumier and Andors 1993).

A renewal of museum-based biogeographic research has taken place in recent years. One locus of this research has again been the AMNH, where ichthyologists Donn Eric Rosen (1929–1988) (e.g., Rosen 1975, 1978; Nelson et al. 1987) and Gareth Nelson, entomologist Norman Platnick (e.g., Platnick and Nelson 1978), and other systematists and biogeographers, have espoused Léon Croizat's (1894–1982) biogeographic views. Croizat was a European botanist who emigrated to Venezuela and whose chief systematic work was concerned with the plant family Euphorbiaceae. Croizat's main method (Croizat 1958) was to accumulate large numbers of distributional "tracks" based on chorological data from plant and animal taxa and then derive "generalized tracks" from overlapping track patterns. Nelson (1973) discussed Croizat's biogeographic work in detail. By blending Croizat's ideas with the theory of phylogenetic systematics proposed by German entomologist Willi Hennig (1913–1976) (Schuh and Wygodzinsky 1977), Rosen, Nelson, and Platnick proposed a new method, called vicariance biogeography, for the analysis of distributional patterns, especially disjunctions (Nelson and Rosen 1981, Humphries and Parenti 1986). The emphasis of this new school was different from that of the dispersalist school. Vicariance biogeographers favor the view that now-disjunct distribution patterns often have their origin in formerly continuous distributions. Random but active dispersal by organisms is considered secondary to more passive dispersal, especially that induced by plate motions (continental drift). One article by Croizat et al. (1974) has been widely cited as the key paper in the development of vicariance biogeography. This theory has been adopted by some North American workers, e.g., Joel Cracraft (1988). But Croizat himself, in a disclaimer written shortly before his death (Croizat 1982), severely condemned the very school of thought which he supposedly co-founded. This extraordinary document is "must" reading for any student of biogeography or of the history of science (Hull 1988). For critiques of Croizat's generalized track methodology and panbiogeography, and of vicariance biogeography, see McDowall (1978), Seberg (1986), and Mayr (1982) respectively. For further discussion of trends in vicariance biogeography, see Platnick and Nelson (1988); for some general comments, Keast (1991).

Adherents of the school of vicariance biogeography divide biogeography into "historical biogeography," where the basic data are extracted from systematic analyses carried out on museum specimens, and "ecological biogeography," where the basic data are field observations (Wiley 1981:277–305). Perhaps the most novel aspect of vicariance biogeography is the superimposition of area cladograms upon taxon cladograms (Vuilleumier 1990).

One recent development in avian biogeography in America (and elsewhere) is a return to a less analytical and more descriptive phase. A few professional ornithologists, helped by legions of amateurs, have started to prepare atlases of distribution using empirical techniques. Two kinds of atlases are being produced: those based on data gathered on a grid basis and those based on breeding surveys or Christmas censuses. Both kinds are compiled from field observations by amateur ornithologists rather than from traditional plots of specimen records by museum specialists.

The present-day surge of atlas writing may have had precursors in the works of Voous (1960, European birds), Stresemann and Portenko (1960, Palearctic birds), and Perring and Walters (1962, British flora) in the Old

World, and in the works of Simpson (1964, North American mammals) and Cook (1969, North American birds) in the New. The gist of Simpson's (1964) method of plotting mammalian distributions (applied by Cook 1969 to birds) was to plot the number of Recent taxa in quadrates 150 miles on each side (Cook used quadrates 153 miles on each side) using distributional checklists documenting the presence of species in each quadrate. From that, "The species density pattern was established by counting species in each quadrate, entering the figures on the map, and contouring by isograms" (Simpson 1964:59).

Atlas maps show with greater precision than ever before, either the breeding (e.g., Adamus n.d., Laughlin and Kibbe 1985) or the wintering (e.g., Root 1988) distribution of avian species. In ornithology the atlas trend seems to have started in Great Britain (Sharrock 1976) and France (Yeatman 1976). To date, only a few causal analyses of atlas data have been made (e.g., Bock et al. 1978).

OVERVIEW

Before discussing schools of thought and reviewing the influence of major figures in American avian biogeography, we present in Table 1 a summary of the preceding sections. In Table 1 we cite only the names of some of the major authors (with one important work for each author) that we associate with each of the three periods described herein.

SCHOOLS OF THOUGHT IN AMERICAN AVIAN BIOGEOGRAPHY

In the course of preparing this review, we found that it was possible to identify several schools of thought associated with specific authors. Moreover, it seemed to us that during the development of North American avian biogeography there was a tendency for one school of thought (or paradigm) to replace another over time. Kuhn (1962, 1970) described a process of paradigm replacement in science that he called "revolution." Kuhn (1970:10) concluded that during the development of a science the achievements of prominent workers were "sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity" and were "sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve." Such

Table 1. Overview of the origins and development of American avian biogeography.

Period	*Authors*	*Topics*
Early Period (origins) 1840s–1890s	Agassiz (1854) Baird (1866) Verrill (1866)	Faunal regions; relationships between North American and Eurasian avifaunas
Early Period (development) 1870s–1920s	Allen (1871) Chapman (1892) Merriam (1890) Grinnell (1915)	Faunal regions; origins of faunas and faunal elements; role of barriers, temperature, habitat; life-zones
Middle Period (growth) 1920s–1960s	Lönnberg (1927) Mayr (1946) Miller (1951)	Origin of faunas and faunal elements; role of history, isolation; ecology
Recent Period (diversification) 1960s	MacArthur & Wilson (1963) Diamond (1969) Johnson (1975) Simberloff (1976) Mengel (1970)	Insular equilibrium; turnover rates; species-area curves; habitat islands; competition; refugia; Pleistocene effects
1970s	Cracraft (1973)	Continental drift; vicariance; area cladograms; areas of endemism
1980s	Root (1988) Olson (1990)	Atlases; biogeographical interpretation of subfossils

achievements he termed "paradigms." Several authors have tried to determine whether paradigm replacement has taken place during the development of geology and geophysics (Kitts 1974), geography (Haggett and Chorley 1967) and biogeography (Nelson 1975, Simberloff 1976, Vuilleumier 1978). Have such replacements occurred in the development of North American avian biogeography? In Table 2 we suggest three biogeographic paradigm replacements and list the principal authors responsible for each, including several workers not discussed in the text.

One example of a paradigm replacement is Mayr's (1946) reaction to what he saw as a static school of thought from Wallace to Allen. Inspired in part by criticisms of Wallacean biogeography by the herpetologist Dunn (1922, 1931), Mayr sought to replace this static view with a new approach that we call "dynamic faunal element analysis." However, the early bio-

Table 2. Schools of thought in American avian biogeography (see text for details).

Author	*Inspired by*	*Reacted against*	*Replaced it with*
Mayr (1946)	Dunn (1922) Lönnberg (1927) Stresemann (1939)	"Static School" Wallace (1876) Sclater (1858) Allen (1893) Heilprin (1883)	Dynamic Faunal Element Analysis
MacArthur & Wilson (1963)	Mayr (1940) Stresemann (1939) Feller (1957) Preston (1962)	"Qualitative Island Biogeography" Mayr (1940) Stresemann (1939)	Dynamic Equilibrium Theory of Insular Biogeography
Nelson (1974) Rosen (1975)	Croizat (1958) Brundin (1966) Hennig (1966)	"Post-Wallacean Dispersalist School" Simpson (1940) Mayr (1946) Darlington (1957)	Vicariance Biogeography

geographers criticized by Mayr were in fact much more analytical in their methods than Mayr acknowledged.

Another paradigm replacement is MacArthur and Wilson's (1963, 1967) substitution of a mathematically formulated theory of "dynamic insular equilibrium" for the "qualitative insular biogeography" of authors like Mayr and Stresemann. Inspired by the work of statisticians like Feller (1957), Fisher (1958), and the biologist Preston (1962), MacArthur and Wilson used probabilistic models to describe immigration and extinction rates on islands as a function of island size. Whereas earlier models were descriptive and historical, MacArthur and Wilson's attempted to model mathematically factors such as immigration and extinction, and relied heavily on the negative correlation between extinction rates and island size.

A third paradigm replacement is Nelson, Rosen, and Platnick's creation of a new school of "vicariance biogeography" (Nelson 1974, Rosen 1975, 1978, Platnick and Nelson 1978; Nelson and Platnick 1981), inspired by Croizat and Hennig (whose ideas they accepted) and by Darlington, Mayr, and Simpson (whose ideas they rejected). Although Croizat is often associated with Nelson and Rosen in the minds of biogeographers as architects of that new theory (Croizat et al. 1974), Croizat himself did not view biogeography as a theory, or as a set of theories, but rather as a method that would allow one to analyze facts (see Croizat 1964:82 for a clear and succinct exposition of his views on biogeography). In short, he was anti-theory and empirical rather than analytic in his method. Furthermore, in a paper written in reaction to a 1979 American Museum symposium on vicariance biogeography (Nelson and Rosen 1981), he rejected Hennig's views (Croizat 1982:294, 298) and disassociated himself from vicariance biogeography and certain of its practitioners (Croizat 1982:299–300).

A fourth example, possibly representing the beginnings of a paradigm replacement, is Storrs L. Olson's rejection of the dynamic equilibrium theory of MacArthur and Wilson (e.g., Olson and James 1982, Olson 1990). On the basis of discrepancies between avian neospecies numbers (MacArthur and Wilson 1967, Juvik and Austring 1979) and paleo- and neospecies numbers on the Hawaiian Islands, Olson and James (1982:635) concluded that "The assumption that the historically known biota of a prehistorically inhabited island contains an intact complement of species in a natural state of equilibrium is invalid for the Hawaiian Islands, and is most likely invalid for other islands as well." Olson and James (1982:635) also stated that "It is probable that the historically known avifauna represents only a third, or less, of the total number of endemic species of birds that were present in the Hawaiian Islands when man first arrived there." Olson (1990:50) added that "At this point, the only safe generalization in island biogeography is that it is not safe to make generalizations."

If the disclosure by paleontologists of hitherto unsuspected avian diversity on islands represents the start of a paradigm replacement, then the next step should be the construction of new species-area curves and either the testing of the MacArthur-Wilson theory or the construction of a new model for insular biogeography.

THE INFLUENCE OF MAJOR FIGURES

Throughout our review we have tried to trace lines of intellectual influence from one author to another or among several authors. Fig. 12 shows some of the trends we have found and outlines a few possibilities that may be of heuristic value.

In the Early Period we identified Louis Agassiz as one of the most significant North American biogeographers, who could perhaps be called the "founder" of the field in North America. Thus we have placed Agassiz at an early node in a major lineage of intellectual influences in Fig. 12. Agassiz was influenced by authors like geographer A. von Humboldt (1805) (Fig. 12) and also several individuals not in Fig. 12, including

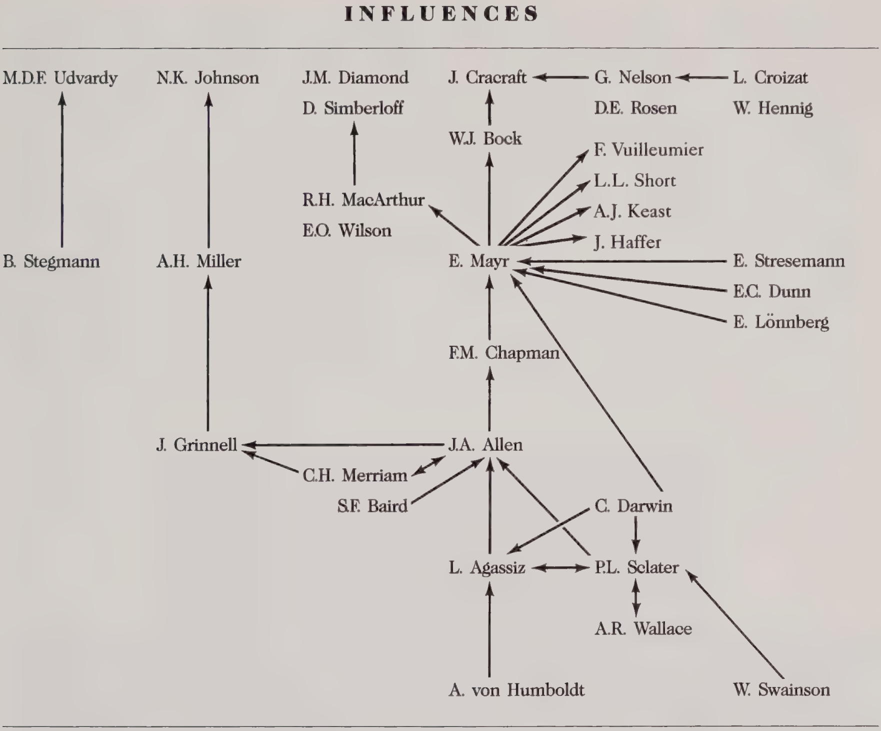

Fig. 12. A schematic diagram of postulated lines of influence in North American avian biogeography (see text for details).

botanist J. F. Schouw (1823) and mammalogist A. Wagner (1844–1845), who published important essays dealing with the distribution of plants or animals (Agassiz 1845b, 1854), and by geologist Charles Lyell (Gould 1979). He was also influenced by Charles Darwin (Lurie 1960), albeit in a "negative" fashion since Agassiz was an anti-evolutionist. Other influences diagrammed in Fig. 12 include those among Darwin, Philip Lutley Sclater, Alfred Russel Wallace (1876), and Agassiz. Sclater in turn was influenced by William Swainson (e.g., Sclater 1858:181), who published a treatise on geography and classification (Swainson 1835). Few authors seem to have analyzed Swainson's biogeographic thinking, but his ideas on classification have been discussed by Stresemann (1975:177–181) and O'Hara (1991). We have not attempted to trace the influence of still earlier authors, such as the botanist Auguste de Candolle (1820), whose work heralded the birth of biogeography (e.g., Nelson 1978).

Agassiz in turn influenced J. A. Allen, who himself had been influenced by Baird. Allen was an important figure in North American avian biogeography and so we place him at a node of several lines of influence, including one extending to Merriam. Allen's influence on Chapman and Grinnell led to two parallel and more or less independent schools, one dominated by Grinnell on the west coast and another, by Chapman, on the east coast.

Another node of influence centers around E. Mayr, who we call the "dean of North American avian biogeographers" because he has exercised a profound influence on the thinking of most of his contemporaries. In a similar manner, Terres (1980:88) referred to F. M. Chapman as the "Dean of American ornithologists in his time." Mayr's own influences can be traced clearly to Darwin's writings (e.g., Mayr 1991) and to more recent

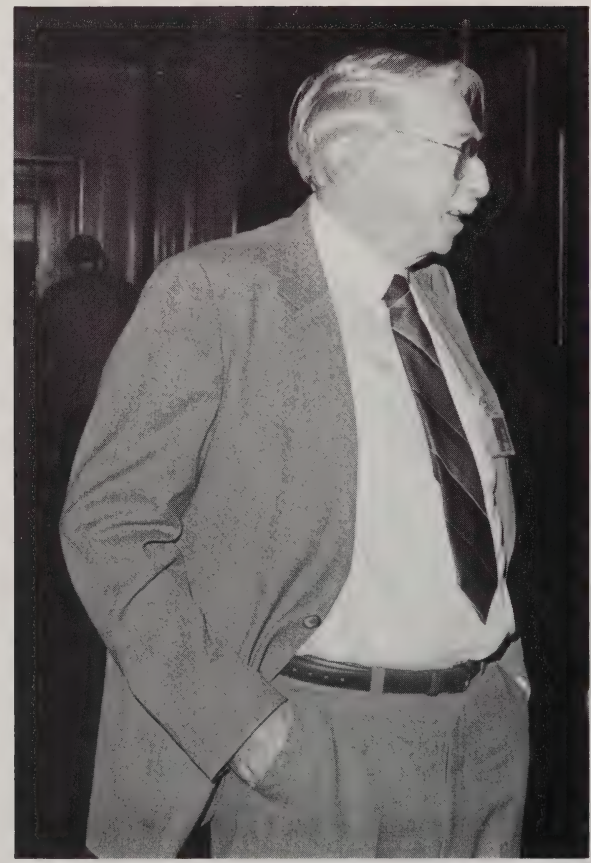

Fig. 13. J. Allen Keast, AMNH, 13 May 1991. Courtesy AMNH.

authors. Some of these, especially E. Stresemann (1889–1992) (Nöhring 1973, Niethammer 1973), who was Mayr's mentor in Berlin, were ornithologists, whereas others were not, such as the herpetologist L. C. Dunn.

In Fig. 12, several lines of influence radiate and diversify from Mayr, representing either continuations or modifications of Mayrian thinking. One line leads to MacArthur and Wilson and two of their successors, D. Simberloff and J. M. Diamond. Separate lines lead to Jürgen Haffer, the originator of the refuge theory (e.g., Haffer 1969, 1974); to J. Allen Keast (Fig. 13), a former student of Mayr, who has worked mostly on Australian avian biogeography (e.g., Keast 1981) and has written general biogeographic reviews (e.g., Keast 1972, 1977); to Lester L. Short, an authority on piciform birds (e.g., Short 1971) who has published on South American (e.g., Short 1975) and African biogeography (e.g., Short and Horne 1991) and whose joint work with Mayr (Mayr and Short 1970) is discussed above; and to François Vuilleumier, who has worked mainly in the southern hemisphere, especially in South America (e.g., Vuilleumier 1986, 1991), and whose biogeographic analyses also include North America (e.g.,

Fig. 14. From left to right: Walter J. Bock, Ernst Mayr, François Vuilleumier; AMNH, 13 May 1991. Courtesy AMNH.

Vuilleumier 1985b). Finally, a line leads to Walter J. Bock, who has discussed Hawaiian honeycreeper biogeography (e.g., Bock 1970, Richards and Bock 1973), and to his former student Joel Cracraft, where another line representing the vicariance biogeography school intersects (e.g., Cracraft 1982, Cracraft and Prum 1988). That school constitutes in part a reaction to Mayr and to other authors of the dispersalist school. Fig. 14 shows Ernst Mayr with two of his former students, Walter J. Bock and François Vuilleumier.

The Stegmann-Udvardy intellectual line is separate from others but this separation does not imply that these two authors occupy an isolated position in the field of avian biogeography. Stegmann was influenced by H. A. Sewertzov and M. Menzbier (Stegmann 1938:78) (not in Fig. 12), and Udvardy was influenced by the plant biogeographer E. Hultén (Udvardy 1963:1147) (not in Fig. 12).

ACKNOWLEDGMENTS

The impetus to write this paper was provided by Edward H. Burtt, Jr. and Richard N. Conner, who invited F. V. to participate in a symposium on “American Avian Zoogeography” at the joint meeting of the Association of Field Ornithologists and of the Wilson Ornithological Society, held at Wheaton College, Massachusetts in June, 1990. This paper is the outgrowth of the presentation given at Wheaton College. Research for, and writing of this essay was greatly facilitated by the abundant bibliographic resources at our disposal at the American Museum of Natural History. Gareth Nelson kindly suggested some useful historical sources. We are deeply grateful to William E. Davis, Jr., Jerome A. Jackson, and Ernst Mayr for critical comments on the manuscript that greatly improved its quality. For help with illustrations we thank Luis F. Baptista (Fig. 7), Bruce M. Beehler (Figs. 2 and 6), Ned K. Johnson and Karen Klitz (Figs. 5 and 11), and Miklos D.F. Udvardy (Fig. 10). Susanna Rosén, editor of *Fauna och flora,* generously allowed us to use E. Lönnberg’s photograph originally published in *Fauna och flora* 37:193, 1942. For kindly providing us with archival photographs we thank Pennington Ahlstrand (California Academy of Sciences, San Francisco; Fig. 7) and William Cox (Smithsonian Institution, Washington, D.C.; Figs. 2 and 6). Jackie Beckett, Craig Chesek, and Denis Finnin of the AMNH Photography Studio expertly printed negatives from the AMNH Photographic Collection which are reprinted in Figs. 1, 3, 4, 9, 13 and 14. Lisa Lydestrom of the AMNH Graphics Department also gave valuable assistance in preparing the illustrations.

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16

The Literature of the History of North American Ornithology

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ABSTRACT.—This chapter is mainly a review of selected publications in the history of North American ornithology. We identify important past historical treatments, but emphasize more recent ones, especially biographical and autobiographical works, since these appear to be the major vehicle for historical information in ornithology. We include references to bird artists and art, conservation, and women in ornithology. We also present a guide to the diversity of resources including catalogs of major ornithological libraries, computerized bibliographic sources, institutional and organizational histories, and reprint series. Also included are sources such as regional and extinct bird journals, popular bird magazines, state and regional bird books, and a brief review of the literature of sciences peripheral to ornithology. The chapter is not exhaustive, but intended rather as a guide for researchers interested in the history of North American ornithology.

As a discipline matures, scholars usually turn to write its history, for from history one can learn the patterns and direction of growth and better understand prospects for the future. Yet ornithology in North America has existed, at least in rudimentary form, for about four centuries, and to date no comprehensive history has been published. Further, the history of ornithology is rarely, and then only cursorily, discussed in any of the current (or past) American textbooks of ornithology. Why?

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We believe that the absence of a comprehensive historical treatment of North American ornithology is a reflection of two closely related factors: (1) the tremendous breadth of a field that grades imperceptibly from amateur hobby to pure science, and (2) the volume and diversity of publications in the field. This same diversity makes it extremely difficult to write a review of the literature.

The purpose of this chapter is to present a characterization of the literature of the history of North American ornithology. In so doing our intentions are (1) to identify important historical treatments of the past, (2) to identify more recent works of major value to the ornithological historian, (3) to describe and provide examples of the present diversity of bibliographic resources in American ornithological history, and (4) to organize and discuss this matrix of materials as a guide for future research. This treatment is not intended as an exhaustive literature review. We specifically ignore many works cited in earlier reviews (particularly Mayr (1975)) to avoid redundancy and focus more on recent publications. Further, we have not attempted to update Mayr's treatment of individual sub-disciplines within ornithology. A truly exhaustive review would require many volumes. Ours is intended as a road map to ease the researcher's journey and identify important landmarks along the way.

We have tried to select references that deal with North American (north of Mexico) ornithology, rather than with American ornithology in general, but because many North American ornithologists and institutions work on birds elsewhere, and many foreign ornithologists work on North American birds, the distinction is, of necessity, blurred. We have also emphasized materials published or developed in recent decades—those that have not been included in previous reviews of ornithological history. Perhaps it is best to say that we have attempted to identify major works of the past and have emphasized recent works relating to North American ornithology.

MAJOR BIBLIOGRAPHIC SUMMARIES AND REVIEWS

In one of the most comprehensives reviews available, Allen (1951) detailed the history of North American ornithology prior to Audubon. In a similar manner, Barrow (1992) reviewed the period from about 1865 through 1935, and Ainley (1985) detailed the history of Canadian ornithology from 1860 through 1950. Kastner (1986) reviewed the development of American ornithology from its beginnings to the present, but in a somewhat superficial and popular fashion. Welker's classic (1955) treatment of nineteenth century ornithology in North America emphasizes biographical materials but contains a chapter on federal and state bird books, and describes the roots of the conservation movement.

Shorter essays have covered periods in the development of North American ornithology. These include the historical preface to the several editions of Coues' *Key to North American Birds* (e.g., 1894) and Shufeldt's (1886) critical analysis of Coues' view of American ornithology and its future. Mayr's (1975) survey of "Materials for a History of American Ornithology" provides a more current outline of the major events and trends in American ornithology and includes an extensive bibliography.

As part of its 50th anniversary celebration, the American Ornithologists' Union (Chapman and Palmer 1933) published a collection of essays treating pattern and process in the development of several specific facets of ornithology (e.g., bird art, bird photography, migration, life history studies, paleontology, bird collections). The present volume is of similar structure, with narrowly focused essays dealing more with the development of places and programs of study than with specific subdisciplines of ornithology.

Several historical monographs of a more international scope have included aspects of North American ornithology (e.g., Sibley 1955, Stresemann 1975, Farber 1982, Tate 1986, Rounds 1990). Importantly, these volumes provide a more global perspective of the context in which American ornithology has developed.

In addition to the bibliographies included in the works mentioned thus far, Coues' (1878, 1879) bibliographies are of immense value to those seeking access to the primary sources of early North American ornithological history. With these bibliographic resources, one can begin to explore almost any facet of American ornithology. Bringing a study up to the present, however, requires search of more recent literature.

BIOGRAPHICAL MATERIALS

Biographical treatment of ornithologists is extensive and indeed, seems to be the major method of exploring American ornithological history. It is people who make history, who initiate ideas and movements, and it is often easier to develop a "story" around a person—perhaps for no other reason than that there is a clear beginning and ending.

Collections of biographies.—Hume (1942) and Palmer et al. (1954) provided collections of biographical sketches of ornithologists. Several other biographical compendia include ornithologists. For example, Peattie (1936) included material on many European scientists who directly or indirectly influenced North American ornithology, as well as material on Wilson, Audubon, and John and William Bartram. Tracy (1930) provided information on the early naturalists but also included biographical material on several twentieth century ornithologists including William Beebe, Edward Howe Forbush, and Frank M. Chapman. Stroud (1985) provides biographical sketches of recent leaders in the American conservation movement. Ewan's (1950) book on naturalists who worked in the Rocky Mountains area includes an extensive section of short biographical sketches featuring ornithologists and naturalists who made ornithological contributions. Batchelder (1937), Root and Elkins (1973), and Davis (1987) provide biographical data for members of the Nuttall Ornithological Club. Similarly, Judd (1979, 1992) provides biographical sketches for several Ontario ornithologists/naturalists. Unfortunately, such collections of biographies are limited, and most biographical sketches are memorials scattered throughout the literature.

Book-length biographies.—While focused on individuals, book-length biographies are of inestimable value to the historian in providing knowledge of the interplay of personalities and the social context of the periods in which the individuals worked.

Recent edited works of early North American naturalists which contain significant ornithological material include Austin's (1967) work on Frank Chapman, Lysaght's (1971) on Joseph Banks, Lottinville's (1973) on Paul Wilhelm, Duke of Wurttemberg, Feduccia's (1985) on Catesby, and Cruickshank's (1986) selections from William Bartram's travels in Florida. Ewan and Ewan (1970) provided some ornithological material in their book on John Banister. A book-length biography has been written about Thomas Nuttall (Graustein 1967), for whom the Nuttall Ornithological Club is named. More recent publications about Alexander Wilson include Stringham's (1958), Cantwell's (1961), and Plate's (1966) biographies, and Hunter's (1983) edited letters of Wilson which includes more than a hundred pages of biographical material.

The biographies, edited works, and essays about Audubon have been legion. Full-length biographies include Herrick (1917), Peattie (1935), and Arthur (1937). More recent works on Audubon include Ford (1964), Adams (1966), Chancellor (1978), and Reynolds (1982). Lindsey (1985) provided a compendium of essays on Audubon as a bicentennial tribute. Other books of edited journals, letters, travels to specific geographic regions, or adventures relating to Audubon include books by McDermott (1951, 1965), Teale (1964), Ford (1967), Corning (1930, reprint 1969), Proby (1974), Keating (1976), and Durant and Harwood (1980). Fries (1973) and Low (1988) provided detailed studies of Audubon's double elephant folio.

The early ornithology of western North America is elucidated by Coan's (1981) biography of James Graham Cooper, Cutright and Brodhead's (1981) biography of Elliot Coues, and Zwinger's (1986a) edited 49 Fort Tejon letters of John Xántus, and Xántus' letters to Spencer Fullerton Baird (1986b).

Among other examples of biographical monographs are Stejneger's (1936) work on an early explorer of Alaska, G. W. Steller; Dall's (1915) and Rivinus and Youssef's (1992) work on Spencer Fullerton Baird; Broley's (1952) book on C. L. Broley; and Wiley's (1954) introduction to selected writings of Ernest Thompson Seton. Welker's (1975) biography provides insight into the personality of the prolific naturalist, scientist, and popularizer, William Beebe. Bond (1980) provided biographical information about her husband, James Bond of the Academy of Natural Sciences of Philadelphia, as did Contosta (1993). Ainley (1993) has added to the historical literature of Canadian ornithology with a biography of William Rowan, and her doctoral dissertation (1985) contains much biographical information (see also chapter 11 this work). Waiser (1989) supplied biographical information on the Canadian ornithologist John Macoun. Sterling's (1974) biography of C. Hart Merriam contains some ornithological material, although it focuses on Merriam's mammal work. Orr's (1992) biography of T. Gilbert Pearson provides a wealth of information on the founding of the Audubon movement. Mathewson (1991) published a biography of bird photographer William L. Finley, and Rothschild's (1983) biography of Lord Rothschild contains an account of the sale and transfer of his substantial bird collection to the American Museum of Natural History. Mason's (1927) description of an ornithological and anthropological trip to Mexico provides insight into the personality of the ornithologist Ludlow Griscom, and more recently Davis (1994) has written a biography of Griscom.

Autobiography.—Autobiographical works have also been prominent and include such efforts as those of W. E. D. Scott (1903), Frank M. Chapman (1933), T. G. Pearson (1937), E. T. Seton (1940), Loye Miller (1950), Roger Tory Peterson (1948), and H. G. Cruickshank (1948, 1968). Major recent autobiographical accounts include those of Stoddard (1969), Murie (1973), Nice (1979), Shortt (1975), Sutton (1979, 1980), Wallace (1979), Bransom (1983), and Pettingill (1992). Autobiographical material relating to birdwatching includes a variety of books, essays, and articles which number in the hundreds or thousands, e.g., Cruickshank (1968), Piatt (1973), Vardaman (1980), and Dunne (1986, 1992).

Miscellaneous Biographical Materials.—A number of books feature biographical material about early explorers, naturalists, and ornithologists, and some include material about recent individuals. Houston (1984a) included biographical material on John Richardson who accompanied John Franklin on an 1820-1822 arctic expedition, and included an appendix of Richardson's bird observations. Eifert (1962) presented material on most of the more important early naturalists of North America, and included chapters which deal with Steller, Captain Cook, Lewis and Clark, the army doctors, and on railroad and boundary surveys. Jenkins (1978) included discussions of Wilson, Audubon, and Lewis and Clark, although most of the book concerns naturalists outside of North America. Peck (1991a) provided much biographical material on J. Cassin in the reprint of Cassin's (1856) work. Murie (1979) included some biographical material about her husband, and many excerpts from his diaries. Elman (1982) included discussions of Mark Catesby, John and William Bartram, Wilson, Audubon, Louis Agassiz, and John Burroughs. Kastner (1986) featured such notables as Spencer F. Baird, William Brewster, Joseph Grinnell, Edward Forbush, Margaret Nice, Chester Reed, Frank Chapman, Ludlow Griscom, and Roger Peterson. Hanley (1977) began with Catesby, and ended with Aldo Leopold and Rachel Carson, and included material on Theodore Roosevelt and the early conservation movement, and artist Louis Agassiz Fuertes. Theodore Roosevelt's early years of bird collecting and his impact on the conservation movement were discussed by Cutright (1985). Huth (1972) included material on William Bartram, Wilson, and the beginnings of the conservation movement. Tate (1986) concentrated mostly on the development of British ornithology but had a chapter on establishing ornithology in the United States. Kastner (1977) contains biographical material on John and William Bartram, Charles Willson Peale (Peale Museum of Philadelphia), Wilson, Audubon, and Constantine Rafinesque, and has an extensive bibliography. Barber (1980) contains a section on the history of the Peale family and their museums. Porter (1986) wove many early naturalists, including Wilson, William Bartram, and Charles Peale into a more general history of American intellectual tradition. Gibbons and Strom (1988) covered, in a popular treatment, many ornithologists and conservationists from early explorers through Wilson and Audubon, Burroughs, and Muir, to recent bird artists Roger Peterson, Arthur Singer, William Zimmerman, and J. F. Lansdowne.

Shorter biographical materials on ornithologists include compendia and individual papers. The Anthropological, Biological, and Philosophical Societies of Washington (1888) published a compendium of four addresses concerning Spencer F. Baird delivered at a commemorative meeting. Mearns and Mearns (1988) provided biographical sketches of 89 individuals of historical importance to ornithology, mostly European, but included such prominent North American ornithologists as Audubon, Wilson, Baird, and C. B. Cory. Their more recent work (Mearns and Mearns 1992) has over 100 biographies of individuals commemorated in English and Latin names of North American bird species, and short sketchs of more than 50 additional individuals whose names are associated with subspecies. Descriptions of explorations, such as those of the northern Pacific (Pearse 1968) usually contain some biographical material. Montevecchi and Tuck (1987) give a thorough treatment of the history of ornithology in Newfoundland, from the earliest explorers to the present.

Many short biographical sketches of ornithologists have appeared in journals. Graustein (1951) provided material on Nuttall's travels. Olsen (1963) provided biographical material on Alexander Wilson. Dall (1927) further described the contributions of Spencer Fullerton Baird, and Deiss (1980) featured Baird and his network of collectors. Largen and Rogers-Price (1985) discussed the ornithology of John Abbot. C. Stuart Houston and several collaborators have published a series of articles which feature Saskatchewan bird banders (e.g., Houston 1958, 1963, 1970, 1989a, 1990a), and a series of articles featuring early oologists (e.g., Houston 1984b; Bechard and Houston 1986; Houston and Bechard 1987, 1990), all in the journal *Blue Jay*. Houston and his wife have published a series of biographical sketches of early North American explorers and naturalists in *Picoides* (e.g., Houston 1989b, 1990b; Houston and Houston 1991) and other journals (e.g., Houston 1988; Houston and Houston 1987). Ainley (1981, 1982) has published biographical material on H. Mousley and L. M. Terrill, and provided material about William Rowan in her paper on conflicting views of scientific research (1988). Peck (1991b) wrote about the science and art of Robert Mengel, while Mengel (1980) included some biographical material in his paper on natural history and art. The major ornithological journals *The Auk*, *Wilson Bulletin*, *Condor*, and *Journal of Field Ornithology*, and others often provide significant historical and biographical information in memorial articles. The *Archives of Natural History*, published by the Society for the History of Natural History (based at the British Museum) often include American ornithological and biographical topics. Some are also included in *Isis*, the journal of the History of Science Society.

Archives at universities, major museums, and other institutions sometimes publish guides to their holdings of individuals, e.g., Cooper and Cox's (1990) guide to the papers of A. Wetmore.

SPECIAL TOPIC/SUBDISCIPLINE HISTORIES

Conservation and Game Management.—Wolfe's (1979) publication of John Muir's journals, spanning more than 40 years, provides further insight into the beginnings of the conservation movement, as do Cruickshank's (1964) introductory remarks on Henry David Thoreau, and McCabe's (1987) and Meine's (1988) biographies of Aldo Leopold. Biographies of Ernest Thompson Seton include those by Samson (1976), Wadland (1978), and Anderson (1986). Other biographies of important people in the conservation movement include Renehan's (1992) book on John Burroughs. Doughty (1975) concentrated on the bird protection battles centering on the millinery trade. Kastner (1986) included further discussion of the conservation movement. The bibliography by Fahl (1977) provides access to much of the early conservation literature. Palmer (1900, 1912) described early events in game protection, and Leopold's book on game management (1933) has a chapter on the history of the subject.

Bird Art and Photography.—Bird artists, in addition to Audubon and Wilson, have received considerable recent attention. Articles by Porter (1989), Richardson (1992), and Rosen (1992) focus on William Bartram and his drawings. Harrison (1964) made available the earliest watercolors of North American birds. Rogers-Price (1983) and Simpson (1993) described the ornitholological contributions of artist/naturalist, John Abbot. Book-length biographical treatment has been given to Rex Brasher (Brasher 1961), Titian Ramsey Peale (Poesch 1961), Allan Brooks (Laing 1979), Roger Tory Peterson (Devlin and Naismith 1977), Francis Lee Jaques (Jaques 1973, Luce and Andrews 1982), and Louis Agassiz Fuertes (Boynton 1956, Peck 1982). Barrett (1976) presents extensive biographical material in his edited journals of artist William Pope. Mary Anderson Pickard (1990) presented a biographical essay as an introduction to her father's (Walter Anderson) bird paintings.

Books which feature bird art or photography often contain substantial biographical material about the artists/photographers, e.g., Ewan's book (1968) on the drawings and paintings of William Bartram, Derry's books (1981, 1985) on the art of Robert Bateman, Warner's (1984) descriptions of Glen Loates, or Peck's (1991c) book on the American bird art of Basil Ede. Peterson's introduction to the "baby elephant folio" of Audubon's work (Peterson and Peterson 1981) presents biographical material on Audubon and touches on the lives and artwork of more than three dozen other bird artists, placing Audubon's art in an historical perspective. Michael Harwood's (1977) 45-page introduction to Eliot Porter's collection of bird photographs treats many aspects of North American ornithological history. Lank's essay (1987) is concerned primarily with natural history illustration outside of North America but does briefly treat Catesby, Wilson, Audubon, Fuertes, and Allan Brooks. Skipwith (1979) briefly treated Catesby, Wilson, Audubon, and Ramsay Titian Peale. Norelli (1975) has biographical material on Catesby, Wilson, Audubon, Fuertes, A. H. Thayer, John White, and Martin Johnson Heade (whose ornithological work focused mostly on Central and South American hummingbirds). Hume (1986) has a Canadian emphasis, and includes biographical materials and interviews with artists including R. Bateman and T. Shortt. Lank's (1986) introduction to Hume's book provides a brief historical survey of wildlife art with a North American emphasis. Van Gelder's (1982) book presents interviews with artists including R. T. Peterson, M. Reese and G. Coheleach, along with reproductions of their art.

Anker (1990) contains a survey of the literature and illustration of descriptive ornithology in the United States during the 19th and 20th centuries. In broader works, an historical perspective on the evolution of bird art is sometimes presented, e.g., Hammond's (1986) treatment of 20th century wildlife art which includes discussions of 14 North American artists. Pasquier and Farrand (1991) included discussion and artwork of North American bird artists Abbott H. Thayer, L. A. Fuertes, Allan Brooks, G. M. Sutton, F. L. Jaques, R. T. Peterson, Don R. Eckelberry, Albert E. Gilbert, Robert Verity Clem, John P. O'Neill, J. Fenwick Lansdowne, Guy Tudor, and Robert M. Mengel. The catalog of an exhibition at Harvard University (Moore 1988) contains brief biographical sketches of several dozen artists and naturalists historically prominent in North American natural history, most of whom made contributions to ornithology.

Women in Ornithology.—Women in ornithology have been featured in a number of recent biographies and edited works. Full length biographies have featured Florence Merriam Bailey (Kofalk 1989), Martha Maxwell (Benson 1986), an early taxidermist and naturalist (and one of two women Corresponding Members of the Nuttall Ornithological Club), and the Texas amateur ornithologist and birdwatcher Connie Hagar (McCracken 1986). Strom's (1986) edited work includes brief biographical sketches of 18 women ornithologists. Ainley (1990) discussed Canadian women ornithologists. Margaret M. Nice (1979) published a largely autobiographical work. Other books which have material on women in ornithology include Ainley (1987), Warner (1979), and Bonta (1991). Brooks (1980) has a chapter on women and birds, and much material, mostly biographical, about literary naturalists and their impact on America.

A GUIDE TO THE DIVERSITY OF RESOURCES IN THE HISTORY OF NORTH AMERICAN ORNITHOLOGY

The following publications demonstrate the complexity of other avenues available to the ornithological historian. Unfortunately, the level of obscurity of a publication in no way indicates the level of its importance. In many ways, the researcher does best to look at the quality of the work that a particular individual has done and then check the publication outlets available to that individual. Some regional publications, such as the *Blue Jay*, the journal of the Saskatchewan Natural History Society, are goldmines of information because of an individual author's (in this case C. S. Houston's) interest and productivity.

Catalogs of major ornithological libraries.—Catalogs to major ornithological library holdings are useful guides for the historically oriented ornithologist. For example, the Hill Ornithology Collection at Cornell is part of the University's History of Science Collections (White 1988). The Department of Manuscripts and University Archives of the Cornell University Library (1987) in their Newsletter listed holdings of ornithological collections, including the papers of Ludlow Griscom, Arthur Allen, and Louis Agassiz Fuertes. The catalog of the Ellis Collection of ornithological works describes that collection at the University of Kansas (Mengel 1972, 1983). Perrault (1987) detailed the McIlhenny Natural History Collection at the Louisiana University Library. Zimmer's (1926) catalog of the Ayer ornithological library at the Field Museum was reprinted in 1991 (no publisher or date given). A catalog (Breit and Clarke 1983) of the ornithological books in the Trinity College Library, Hartford, Connecticut, was recently brought up to date (Clarke 1991). The catalog of the ornithological books at the Yale University Library (Ripley and Scribner 1961) was recently reprinted (no date given), as was Wood's (1931) classic on vertebrate zoology literature at Blacker Library, McGill University.

Other Bibliographies.—Some bibliographies treat subjects, e.g., Lincoln (1928) on bird banding or Laird (1980) on the natural history of Newfoundland and Labrador, institution publications, e.g., Geare's (1902) listing of United States National Museum publications, or the work of individuals, e.g., Goode's (1883) bibliography of Baird's writings or Berra's (1977) bibliography of William Beebe. The American natural history bibliography by Tucher (1985) identifies resources in several libraries. Memorial articles on prominent ornithologists in *The Auk* formerly included, in many instances, bibliographies of their publications (e.g., Allen 1901 on George B. Sennett; Wetmore 1943 on J. H. Riley). This practice has been largely abandoned in recent years, but see Parkes (1970) on W. E. Clyde Todd.

Computerized bibliographic sources.—The computer age now allows one to search thousands of resources at the touch of a finger, sorting materials by author and subject. Most college and university libraries provide such services and one can walk out with a typed bibliography or even a collection of abstracts of articles retrieved in a matter of minutes. For example, the data base *American: History and Life*, is a standard for the bibliography of American history. *Biological Abstracts, Zoological Record*, and other standard bibliographic references are now available for computer-assisted searches. Dissertation Abstracts, now available on computer diskette, can be rapidly searched, and abstracts can be down-loaded to personal diskettes for future reference.

Institution and organization histories.—Several histories of organizations and institutions present materials relevant to the history of North American ornithology. Among these are the histories of the federal Bureau of Biological Survey (now U.S. Fish and Wildlife Service) (Cameron 1929), the Boston Society of Natural History (Creed 1930), and Hawk Mountain Sanctuary (Broun 1948). Murphy's (1943) biographical material on Robert Cushman Murphy also includes information about the American Museum of Natural History. Dall's (1915, 1927) works on Spencer Fullerton Baird also focus on ornithology at the Smithsonian.

The Audubon movement has been chronicled by Graham (1990) and Orr (1992). This work supplements the classic autobiographical work by Pearson (1937). The history of the New York Zoological Society (Bridges 1974) contains ornithological material. Histories of the Wilson Ornithological Society (Jackson 1988, Jackson et al. 1988, Hall 1988, Mayfield 1988) and Nuttall Ornithological Club (Davis 1987) complement the work of Swarth (1929) on the history of the Cooper Ornithological Society. Davis (1994) contains information on the history of the American Ornithologists' Union and the Boston Society of Natural History. Kastner (1986) discussed the history of several ornithological organizations including the Wilson Ornithological Society and the Delaware Valley and Nuttall ornithological clubs. A history of the Zoology Department at University of California Berkeley, an important location for ornithological research, was written by Eakin (1988) and was expanded upon with an ornithological focus in chapter 8 of this volume. The Cornell Laboratory of Ornithology, treated by Harwood (1987) has also been chronicled in chapter 9 of this volume. Albright (1985) traced the early development of the National Park Service. In a short article Cannell (1983) discussed some aspects of the founding of the American Ornithologists' Union. In a broader context, Mayr (1984) and Konishi et al. (1989) discussed the contributions of ornithological research to other areas of biology. Kohlstedt (1991) presented a biographical essay on G.B. Goode, and Goode's essays focus on museum history and natural history.

Books which deal with natural history museums include Sellers (1980) on the Peale Museum, Orosz (1990) on the museum movement in America, and Winsor (1991) on the Agassiz Museum. Institutions and societies frequently have publications which have historical aspects. For example, the National Audubon Society published proceedings of a symposium on the amateur in ornithology (McCrimmon and Sprunt 1978) and the Cornell Laboratory of Ornithology's *Living Bird* series included Ainley's (1979) paper on the contributions of the amateur to American ornithology.

Reprint series.—A number of early works, many of which are rare, that contain some ornithological materials have been reprinted. For example, the "Great Americana" series published by Readex Microprint includes reprints of John Bartram (1751), Charlevoix (1744), and Bradbury (1817; 1819 edition also reprinted). The 1763 edition of Roberts' adventures in Florida, which makes two references to birds, was republished for the Florida Bicentennial (1976).

Arno Press has published the series "Natural Sciences in America," reprinting more than 20 volumes that have been long out of print. Many include much material of ornithological interest (e.g., Nuttall 1832, 1834).

Regional bird journals.—Regional bird journals, journals of state academies of science, and the journals of local and state bird or ornithological societies are often a source of historical information, especially biographical. For example Johnston (1989) wrote about J. E. Gould, an early oologist, Septon (1991) wrote a memorial article on Owen J. Gromme, and Tanner (1990) provided historical information on the Tennessee Ornithological Society. Clench (1991), Mayfield (1991), Tautin (1991), and Yunick (1991) all published papers on aspects of the amateur in ornithology in a single issue of *Bird Observer* (Massachusetts). Komarek (1972) wrote about Herbert L. Stoddard, Sr., Scott (1961) about Stephen Alfred Forbes, and Hoyt (1964) about A. A. Allen. In more cosmopolitan magazines, including *Nature Magazine*, and *Audubon Magazine*, biographical sketches by Dall (1927), McAtee (1953, 1954a,b,c,d), Peattie (1927), Peck (1983) (about Louis Agassiz Fuertes), and Teale (1945, 1946) featured important North American ornithologists. The evolution of ornithological field guides was discussed by Bair (1979), Walton (1986), and Sorrie (1987), all in local journals.

Popular bird and nature-oriented magazines.—Popular bird magazines often publish notes and articles of historical interest, and although these usually represent secondary resources, they sometimes publish new material or valuable new interpretations. For example *Living Bird Quarterly* (now *Living Bird*) has published articles by Bonney (1991) on the contribution of amateurs, Kiff (1989) on oology, Breslav (1985) about

Audubon, Pierson (1986) about Manomet Bird Observatory, and Swanson (1990) a biographical sketch of the Arthur Allen Award recipient, Harold Mayfield. Peterson (1980, 1984) wrote about the evolution of field guides in *Defenders* and *National Wildlife*, and Peck (1987) presented biographical material on artist Terence Shortt in *International Wildlife.*

Birder's World, Wild Bird, Audubon Magazine, Bird Watcher's Digest, Natural History, Smithsonian, and many other popular magazines should likewise not be overlooked as resources for the history of American ornithology.

Extinct bird journals.—In addition to the plethora of current journals that deal more or less with birds, there are literally dozens of small journals that have become extinct. The heyday of natural history in the waning decades of the 19th century spawned these journals/magazines, often published by young entrepreneurs most interested in enhancing their own collections of bird eggs and skins. Some, such as *The Oologist*, survived for decades. Others passed quietly into oblivion after only an issue or two. Some contain material of scientific value. Many contain material of historical interest, and they, of themselves, are of intrinsic historical interest. Burns (1915) describes many of these publications and Jackson (1986) discusses the phenomenon from an historical perspective.

Although there were many journals that became extinct in the waning years of the 19th century and early years of the 20th century, the phenomenon continues. *Continental Birdlife*, for example, lasted for only a few volumes. Another, *The Jack-Pine Warbler*, has changed dramatically from a top rate journal with much of scientific and historical value to a newsletter format of limited enduring value.

Any student of American ornithological history will want to take advantage of material from some of these journals. The Josselyn Van Tyne Memorial Library, housed in the Museum of Zoology at the University of Michigan, has one of the better collections of extinct journals (see the bibliography by Underwood 1954).

State and regional bird books.—State and regional bird books are often an excellent source of historical information. Some have extensive historical sections, such as Todd's books on western Pennsylvania (1940) and Labrador (1963). The latter contains detailed descriptions of the 25 Carnegie Museum expedition itineraries to the area. The following exemplify other such books with regional history information: Bailey and Niedrach (1965, Colorado), Baumgartner and Baumgartner (1992, Oklahoma), Burleigh (1958, Georgia), Gabrielson and Lincoln (1959, Alaska), Howell (1932, Florida), James and Neal (1986, Arkansas), Ligon

(1961, New Mexico), Mengel (1965, Kentucky), Oberholser (1974, Texas), and Robbins (1991, Wisconsin).

The literature of peripheral sciences and other disciplines.—The conservation movement has received much attention, and we present here only a few landmark works and a few works with extensive references. Hornaday's original 1913 work on vanishing wildlife has been recently reprinted (1970). Matthiessen's 1959 book on American wildlife contains much historical material and has been reissued (1987). Many books on institutions contain historical material of importance, e.g., Allen (1987) on the National Wildlife Federation, and Clary (1986) contains a chapter on the national forests and the struggle for conservation. The Audubon Wildlife Report series published by the National Audubon Society featured one of the U.S. federal services in each issue and usually presented an historical perspective, e.g., the U.S. Forest Service (Di Silvestro 1986). Regional works sometimes present historical material relevant to the conservation of birds, e.g., Gill (1985). The *Atlas of Breeding Birds in Pennsylvania* (Brauning 1992) includes an excellent historical section. Several symposia have focused attention on conservation problems for major groups of birds, and may be considered landmark publications. Examples of such symposia include Bartonek and Nettleship (1979) for marine birds, Keast and Morton (1980), and Hagan and Johnston (1992) for Neotropical migrant birds. Neotropical migrants are also featured in Terborgh (1989).

ACKNOWLEDGMENTS

We thank Brian E. T. Cassie and John C. Kricher for critically reading earlier drafts of the manuscript. We especially thank Mark V. Barrow, Robert M. Peck, and Kenneth C. Parkes for their thoughtful criticism of the manuscript and suggestions on references we should include.

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